THE HAWAIIAN PLANTERS' MONTHLY

PUBLISHED FOR THE

HAWAIIAN SUGAR PLANTERS' ASSOCIATION

VOL. XXIV.] HONOLULU, MARCH 15, 1905. [No. 3

WEATHER AND CROPS.

March, 1905, was divided into two very different thermal periods of about equal length, the first half of the month being abnormally cold, while the latter half displayed temperatures uniformly above the normal. Considered as a whole, however, the month was cooler than the average for this season of the year. At Honolulu, the mean daily departure from the normal temperature was 0.8 degrees.

Although considerable rain fell in most sections of the group during the first and third decades of the month, the second decade was quite dry, and the average precipitation for the entire month was considerably below the normal in most localities. Considered by districts, the approximate percentages of actual rainfall, as compared with the normal, were as follows: Hawaii—Hilo district, variable, from 36 per cent. in the extreme southern portion to 90 per cent. in the extreme northern portion; Hamakua district, 82 per cent.; Kohala district, 99 per cent.; Kona district, 41 per cent.; Kau district, 14 per cent.; Puna district, 30 per cent. (estimated). Maui—Variable, from 10 per cent. (estimated) on the leeward coast to 90 per cent. (estimated) along the windward coast of eastern Maui. Oahu—Koolau districts, 48 per cent.; Honolulu district, variable, from 18 per cent. in the lower levels to 32 per cent. in the upper Nuuanu valley; Ewa district, 25 per cent. (estimated). Kauai—Waimea district, 8 per cent.; Kona district, 28 per cent.; Puna district, 14 per cent.; Northern districts, 42 per cent.

The growth of young cane during the month was, in general, far from satisfactory; for the showers during the first week did little more than counteract the injurious effects of the February drought and the cold and dry weather of the middle decade operated as a severe check. The warmer and moist weather during the latter part of the month, however, was of material benefit in most sections. Cane harvesting and grinding proceeded rapidly; but shortage of water during the middle of the month seriously interfered with the fluming of matured cane and the proper irrigation of young cane in some localities. The leafhopper caused considerable damage during the dry weather. Planting for the 1907 cane crop became quite general during the month, but had to be suspended at intervals on account of the drought. A high wind on the 10th instant slightly injured young cane in the Koolauloa district of Oahu. Rice grew well all month, being unaffected, apparently, by the rather variable weather conditions. Harvesting of the winter crop of pineapples was practically completed during March, the yield being very satisfactory. The development of fruit buds for the summer crop of pines was somewhat checked and considerable yellowing of the plant leaves was noted during the dry spell; but normal color was restored by the late showers, and at the close of the month the plants were growing nicely. Coffee trees blossomed to some extent in all sections during the month, but suffered from the drought in leeward Hawaii and windward Oahu, and were only saved from very serious damage by the rains during the last week. The young coffee trees in Kona, Hawaii, made slow but steady growth despite the drought. As a whole, pastures were in very poor condition throughout the entire month, except in windward sections where they were revived at intervals by the showers. The scarcity of grass and shortage of water caused much suffering among grazing stock, more especially in the leeward and northern portions of the group.

ANNUAL REPORT OF QUEENSLAND SUGAR INDUSTRY.

We are in receipt of a copy of the fourth annual report of the Bureau of Sugar Experiment Stations dealing with the sugar industry of Queensland for the year 1903-1904, prepared by Dr. Maxwell.

In view of the experiments with different varieties of cane, now being carried on here, the portion of the report, showing the results attained in Queensland along these same lines will be of interest to sugar planters of Hawaii. The table showing cost of production would be more easily understood and comparable if somewhat more in detail, and if the Queensland methods were better known.

Doctor Maxwell's work in Queensland has been carried on under much difficulty and with no little opposition. In spite of all this, however, there is being gradually introduced into Queensland through his efforts, better and more successful methods of cane cultivation. The average yield in 1903 was 13.65 tons of cane and 1.52 tons of sugar. This, Doctor Maxwell says, can be doubled and without any other means than are in common practice in the most progressive cane-growing countries.

*INTERNATIONAL SUGAR SITUATION.**

By Frank R. Rutter.

[Continued from February No., page 89.]

CANE-SUGAR PRODUCTION.

Attention has already been called to the remarkable increase in the production of beet sugar relative to the production of cane sugar. In 1899-1900 beet sugar constituted no less than 64 per cent. of the total visible sugar production of the world. This was due not only to the enormous increase in the output of beet-producing countries, but also to the temporary cessation of the Cuban supply of cane sugar. Owing to the resumption of sugar production by Cuba and the restriction of the beet-sugar output the commercial production of cane sugar increased from 36 per cent. of the world's crop in 1899-1900 to 42 per cent. in 1902-3 and 1903-4. If allowance were made for the cane-sugar product omitted from commercial statistics more than half of the total production would be found to consist of cane sugar.

Of the cane-sugar output for 1903-4, Cuba produced no less than 24 per cent., Java about 21 per cent., Hawaii 8 per cent., and Louisiana 5 per cent. Considerably more than half the visible cane-sugar production of the world was thus supplied by the first three sources named.

Sugar statistics for cane-growing countries are, in general, by no means so complete or so accurate as for beet-growing countries. The sugar problem of the world is most closely associated with the beet-sugar industry. No attempt will be made to treat exhaustively of the cane-sugar industry, but the conditions of production in Cuba, Java, Hawaii, and Louisiana will be briefly described.

CUBA.

SUGAR PRODUCTION.

The Cuban sugar industry during the year 1903-4 is estimated to have furnished nearly one-fourth of the entire visible cane-sugar product of the world.

The decline of the Cuban output from more than 2,250,000,000 pounds in 1894-5 to 500,000,000 in 1895-96 shows strikingly the effect of the war on the industrial life of the island. Of the 574 sugar factories on the island[b] 483 were destroyed during the war. Less than 12 per cent. of the number existing at the outbreak of the war were left.

The recovery of the industry from the effects of the war has been rapid. The estimated production for 1903-4 reached 2,307,000,000 pounds. The output for that year was surpassed only by that for 1893-94. (See Table 44.[c])

TABLE 44.—*Production of sugar in Cuba,* 1880-81 *to* 1903-4.

Crop year.	Production. Long tons.	Production. Pounds.	Crop year.	Production. Long tons.	Production. Pounds.
1880-81...	493,764	1,106,031,360	1892-93...	815,894	1,827,602,560
1881-82...	595,837	1,334,674,880	1893-94...	1,054,214	2,361,439,360
1882-83...	460,397	1,031,289,280	1894-95...	1,004,264	2,249,551,360
1883-84...	553,987	1,240,930,880	1895-96...	225,221	504,495,040
1884-85...	631,967	1,415,606,080	1896-97...	212,051	474,994,240
1885-86...	731,723	1,639,059,520	1897-98...	305,543	684,416,320
1886-87...	646,578	1,448,334,720	1898-99...	345,260	773,382,400
1887-88...	656,719	1,471,050,560	1899-1900.	308,543	691,136,320
1888-89...	560,333	1,255,145,920	1900-1901.	635,856	1,424,317,440
1889-90...	632,368	1,416,504,320	1901-2....	850,181	1,904,405,440
1890-91...	819,760	1,836,262,400	1902-3....	998,878	2,237,486,720
1891-92...	976,789	2,188,007,360	1903-4....	1,030,000	2,307,200,000

LOCALIZATION.

According to the census of Cuba for 1899,[a] taken by the United States War Department, nearly one-half of the entire cultivated land was devoted to sugar cane. The area of culti-423,917 acres, or 47 per cent. of the whole. In the Province of Matanzas 78 per cent. of the cultivated land was in sugar cane; in Santa Clara, 71 per cent.; in Puerto Principe and Santiago, 35 per cent.; in Habana, 27 per cent., and in Pinar del Rio, 6 per cent.

AVERAGE YIELD.

The agricultural report of Cuba for 1900[b] estimated the average yield at 21 short tons of cane per acre of good land (about 50,000 to 60,000 arrobas per caballeria), and the average sugar extraction at 10.50 to 11 per cent., or about 4,500 pounds of sugar per acre. In 1899 sugar cane occupied 422,486 acres, and in 1899-1900 the output was 691,136,320 pounds of sugar,

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[a] For Louisiana, see pp. 91-93.

[b] Exclusive of the Province of Santiago. The statistics given are taken from the Civil Reports of the Military Governor of Cuba, 1900, Vol. VII, p. 295. See also ibid., 1901, Vol. VII.

[c] Compiled from Willet & Gray, December 31, 1902, and September 22, 1904. Reports of the Cuban Department of Agriculture, Commerce, and Industry return the sugar output for 1900-1901 at 1,392,381,000 pounds, for 1901-2 at 1,952,453,800 pounds, and for 1902-3 at 2,302,603,400 pounds.

an average of only 1,636 pounds per acre. That yield was undoubtedly much below the normal. Unfortunately no statistics of acreage are available for later years. Official statistics of production show an average extraction of 9.71 per cent. in 1900-1901, 9.95 per cent. in 1901-2, and 9.69 per cent in 1902-3.

JAVA.

During the cessation of the Cuban industry Java was the leading source of cane sugar. It is now second only to Cuba. During the sugar year 1903-4 it is estimated that Java alone produced more than one-fifth of the total cane-sugar product of the world, so far as included in commercial statistics.

An export duty of 5 cents per 100 pounds (0.30 florin per quintal) was collected prior to 1887. The duty was then reduced to one-half and was suspended from June 1, 1887, to December 31, 1893, and from June 1, 1895, to May 31, 1896. It was finally abolished by the law of February 1, 1898.

LAND TENURE.

The land tenure of Java is quite complicated. The Dutch Government holds the title to a large part of the land. In two provinces—Soerakarta and Djokjakarta—native princes control the land. The bulk of the land in private hands is owned by the natives, who lease part of it to sugar factories for a single crop year. Part of the Government land formerly passed into private ownership. The Government no longer alienates any land, but since 1870 has granted it on hereditary lease (emphyteusis) for a term of seventy-five years.

SUGAR PRODUCTION.

During the last twenty years the sugar production of Java has increased threefold. In 1882 the total production was 654,000,000 pounds. In 1901 it amounted to 1,780,000,000 pounds, and in the following year to nearly 2,000,000,000 pounds.

Until about 1875 practically the entire sugar industry was operated directly by the Government. It was then decided to bring the industry gradually under private control. The Government made contracts with factories to work cane grown on Government land, but required them to supplement such supplies with cane grown on land under private ownership: Government culture was to be decreased annually and private

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[a] Census of Cuba, 1899, pp. 543-549.

[b] Civil Reports of the Military Governor of Cuba, 1900, Vol. VII, pp. 48-49.

culture to increase. After 1891 Government culture and manufacture under Government contract came to an end.

Factories growing cane on lands annually leased from the natives increased their output from 80,000,000 pounds in 1882 to 222,000,000 pounds in 1891. The following year this class, including the factories that had previously operated under contract with the Government, had a sugar output of 764,000,000 pounds. In 1902 sugar factories of this class produced 1,575,000,000 pounds out of a total production for the island of 1,963,000,000 pounds. Factories using cane grown on lands of native princes produced 285,000,000 pounds. The remainder, 103,000,000 pounds, was extracted from cane grown on lands owned or leased for long periods by Europeans and Chinese.

AVERAGE YIELD.

Complete statistics of acreage and cane crushed are not available. The results obtained by the sugar industry, as tabulated by the Archief voor de Java Suikerindustrie, show an average yield of from 30 to 40 short tons of cane per acre and an average extraction of 9½ to 11 per cent. The net sugar production per acre has varied from 6,600 pounds in 1894 to 8,300 pounds in 1899. (See Table 46.) These results indicate a much higher yield of cane per acre than in Cuba.

TABLE 46.—*Results obtained in the Java sugar industry*, 1894-1903.[a]

	Average yield of cane.		Average sugar produced.		
	Per bouw. *Piculs.*	Per acre. *Short tons.*	Per bouw. *Piculs.*	Per acre. *Pounds.*	Per cent of cane.[b] *Per cent.*
1894	782	30.32	85½	6,629	10.36
1895	888	34.43	90¾	7,036	9.79
1896	789	30.59	86⅞	6,736	10.55
1897	875	33.92	91¼	7,075	10.06
1898	1,011	39.19	106	8,219	10.21
1899	949	36.79	106½	8,258	10.94
1900	979	37.95	96	7,444	9.57
1901	888	34.43	92¼	7,153	10.16
1902	[c]80,242	35.80	[c]8,930	7,967	10.77
1903	[d]711	39.82	[d]71	7,952	10.04

[a]Data from the Deutsche Zuckerindustrie, 1903, pp. 850, 1161, and International Sugar Journal, 1904, p. 339. The statistics are apparently obtained originally from the Archief voor de Java Suikerindustrie.

[b]The percentages given are somewhat lower than would be obtained by dividing the average yield of cane per bouw into the average production of sugar per bouw. The difference is probably to be explained by the inclusion of so-called sack sugar at its actual weight in the preceding column (except for 1903), but only at half its actual weight in calculating this column.

[c]Kilograms per hectare.

[d]Hundredweight per acre.

PRICES.

The prices of sugar in Java are shown in Table 47. They have followed very closely the marked decline in the export prices of beet sugar. In 1883 the average price was 4¼ cents per pound; in 1903, less than 1¾ cents.

TABLE 47.—*Average price of raw sugar No. 15 Dutch standard*[a] *in Java,* 1883-1903.

Calendar year.	Per pound. Cents.	Calendar year.	Per pound. Cents.
1883	4.28	1894	2.34
1884	3.29	1895	1.42
1885	3.00	1896	2.38
1886	2.73	1897	1.98
1887	2.71	1898	1.98
1888	2.77	1899	2.06
1889	2.93	1900	2.11
1890	2.44	1901	1.95
1891	2.50	1902	1.63
1892	2.57	1903	1.71
1893	2.88		

[a]Prior to 1896 No. 14 Dutch standard.

EXPORTS.

The exports of sugar from Java during the last twenty years increased from 700,000,000 pounds in 1883 to 1,900,000,000 pounds in 1903. (See Table 48.[a]) Shipments to the Netherlands were small.

TABLE 48.—*Exports of sugar from Java,* 1882-1903.

Calendar year.	Pounds.	Calendar year.	Pounds.
1882	683,708,000	1893	1,118,801,000
1883	663,935,000	1894	916,807,000
1884	790,971,000	1895	1,269,098,000
1885	926,741,000	1896	1,261,335,000
1886	738,492,000	1897	1,142,649,000
1887	852,896,000	1898	1,512,531,961
1888	828,257,000	1899	1,713,638,076
1889	696,080,000	1900	1,623,904,000
1890	810,808,000	1901	1,595,393,334
1891	1,021,936,000	1902	1,904,348,584
1892	937,757,000	1903	1,919,459,000

NOTE.—The quantity of sugar exported to the United States for certain years was as follows: 1898, 930,448,822 pounds; 1899, 1,223,800,028 pounds; 1901, 707,564,302 pounds; 1902, 968,208,201 pounds. The shipments to the United States formed 61.52 per cent. of the total sugar exports in 1898, 71.42 per cent. in 1899, 44.35 per cent. in 1901, and 50.84 per cent. in 1902.

In 1899 over 71 per cent. of the total sugar exports of Java were destined for the United States. In 1902, notwithstanding the increased receipts from Cuba, the United States took 51 per cent. of the total shipments from Java. The other half of the sugar exports in that year went to neighboring countries of the East. China alone received over one-fourth of the total exports, while nearly all of the last fourth was shipped to Australia, Japan, the Straits Settlements, and India. The sugar exports both to the Netherlands and the United Kingdom formed only one-half of 1 per cent. of the total in 1902.

HAWAII.

More than three-fourths of the total cultivated land in Hawaii was devoted to sugar cane in 1899. The total cultivated area, according to the United States census of 1900, was 86,854 acres; the acreage in sugar cane, 65,687.

ACREAGE AND SUGAR PRODUCTION.

In 1895 the area planted in cane was 47,000 acres and by 1901 it had increased to 79,000. The production of sugar increased much more rapidly. In 1895 the total production amounted to less than 300,000,000 pounds; by 1901 it had increased to 720,000,000 pounds. The average yield per acre in the earlier year was only 6,300 pounds of sugar, and in 1901, 9,200 pounds. (See Table 49.[b]) These results in most years exceed even those obtained in Java.

TABLE 49.—*Acreage in sugar cane and production of sugar in Hawaii, 1895-1901.*

Year.	Area in cane. *Acres.*	Sugar produced. *Pounds.*	Average yield per acre. *Pounds.*
1895	47,400	299,254,000	6,313
1896	55,729	451,656,000	8,105
1897	53,826	502,252,000	9,331
1898	55,236	458,828,000	8,307
1899	60,308	565,614,000	9,379
1900	66,773	579,088,000	8,672
1901	78,619	720,076,000	9,159

In 1899, according to the Twelfth Census of the United States, 2,239,376 tons of cane were harvested in Hawaii. Practically all of the cane was made into sugar on the plantation. Only 172,544 short tons of cane were sold, at an average price of $4.23 per ton. From each acre of land no less than 34 tons were obtained—about twice the usual yield in Louisiana and but slightly less than that in Java. In Louisiana, moreover, nearly one-third of the crop had to be retained for use as plant cane, while in Hawaii all the cane harvested was crushed.[a] In Hawaii, as in Java, sugar cane is raised very largely by means of irrigation.

The sugar production of the islands in 1899-1900 was returned by the census at 542,098,500 pounds and the production of molasses at 4,702,292 gallons. Most of the molasses produced had no selling value, owing to the almost complete extraction of the saccharine matter in the form of sugar. From each short ton of cane crushed an average of 242 pounds of sugar were obtained, or 12.10 per cent. of the weight of the cane, and from each acre 8,253 pounds of sugar. The average extraction was remarkably high, exceeding the highest recorded for Java by more than 1 per cent.

EXPORTS.

Practically the entire sugar production of Hawaii is shipped abroad, mostly to the United States. Consequently the exports indicate very closely the output of the insular industry. During the quarter of a century that the reciprocity treaty was in effect Hawaiian exports increased from 25,000,000 pounds in 1875 to 545,000,000 in 1899. Under American sovereignty the exports further increased to 775,000,000 pounds in 1902-3 and 736,000,000 pounds in 1903-4. With the improved methods of sugar production there has been a continually decreasing exportation of molasses.

SUGAR-IMPORTING COUNTRIES.

The United Kingdom and the United States import more sugar than any other countries. While the former has important sugar-producing colonies and the latter a considerable domestic production, both countries import a large quantity of sugar. With sugar production in many countries far in excess of domestic needs it has become increasingly necessary and increasingly difficult to find foreign markets for the surplus production.

UNITED KINGDOM.

The United Kingdom is the great sugar market of the world. In that country both beet and cane sugar compete on equal terms, save for the advantage the former derives from lower freight rates. No advantage whatever has been granted in

[a]For 1898, 1899, 1901, and 1902 from the Statistik van den Handel, de Scheepvaart en de In-en Uitvoerrechten in Nederlandsch Indie; for other years, from the Jaarcijfers.

[b]Compiled from the Hawaiian Planters' Monthly, vol. 21, p. 625; vol. 22, p. 186.

[a]Twelfth Census, Vol. VI, pp. 459, 462.

favor of the British colonies. British prices represent the equilibrium reached as the result of competition between the beet and cane product.

Extremely low sugar prices have prevailed. But the competition which the British sugar colonies have been compelled to meet has been severe. For several years the West Indian colonies have depended on the United States for a market. The unsatisfactory conditions in those colonies seemed in the opinion of the British Government to render some change imperative, and the British delegates to the Brussels Conference were instructed to insist on the repeal of the continental sugar bounties.

On April 19, 1901, a duty of 91 cents per 100 pounds (4s. 2d. per cwt.) was imposed on refined sugar and a duty on raw sugar varying according to polariscopic test. The duty on raw sugar in 1903 averaged 73 cents per 100 pounds.

IMPORTS.

The sugar imported into the United Kingdom increased from 2,600,000,000 pounds in 1883 to 3,500,000,000 in 1903.

In 1883 more than one-half of the total imports consisted of raw cane sugar. In 1903 such sugar represented only 12 per cent. of the total supplies. The British colonies alone furnished in 1883 one-fifth of the total sugar imports of the United Kingdom. In 1902 they supplied only 6 per cent., and in 1903 only 4 per cent.

In place of the raw cane sugar formerly imported, refined sugar, mainly from beet-producing countries, is now received. Such sugar in 1883 constituted only 14 per cent. of the total imports. In 1903 about 60 per cent. of the total receipts consisted of refined sugar. The quantity of raw beet sugar imported has remained almost constant during the last twenty years. In 1883 923,000,000 pounds of such sugar was received, and in 1903, 989,000,000 pounds.

PRICES.

With no tax on sugar and no import duty until 1901, prices fell with the increasing surplus production of continental beet sugar and the need of marketing it abroad. The average price of the raw beet sugar imported into the United Kingdom in 1883 was 4.34 cents per pound. The average price for 1902 was 1.56 cents. The price of raw cane sugar fell almost as much, from 4.39 cents in 1883 to 1.91 cents in 1902. The fall in refined sugar prices was even more marked, from 5.91 cents per pound in 1883 to 2.29 cents in 1902. The average prices for 1903 show a slight increase. These prices are exclusive of duty.

UNITED STATES.

In spite of its considerable domestic sugar production, the United States is still compelled to import annually a large quantity of foreign sugar. In many years its imports have been even greater than those of the United Kingdom.

During the fiscal year ending June 30, 1904, the sugar imports of the United States amounted to about 4,700,000,000 pounds. This included about 1,000,000,000 pounds imported from Hawaii and Porto Rico and 62,000,000 pounds from the Philippine Islands. Cuba furnished 2,761,000,000 pounds. In addition to the imports, the domestic sugar industry produced nearly 1,000,000,000 pounds, consisting almost equally of beet and cane sugar.

The tariff act of 1890, which removed the import duty from all raw sugar and reduced the duty on refined to one-half cent per pound, imposed an additional duty of one-tenth cent per pound on sugar above No. 16 Dutch standard in color that received a foreign bounty greater than that paid on lower grade sugar. The rate fixed was probably intended to cover the difference between the German bounty on raw and on refined sugar. Under the act of 1894 the countervailing duty was retained at one-tenth cent per pound, but was extended to all bounty sugar. The act of 1897 contained a general provision that all articles receiving directly or indirectly export bounties from foreign countries should be subject to an additional duty equal to the bounty received. Under this provision the Secretary of the Treasury from time to time fixes the rate of additional duty to be imposed on sugar from various foreign countries.[a] In 1899 a similar provision was inserted in the tariff of British India.

These provisions served to stimulate the importation of cane sugar rather than of beet sugar into the United States and India, and also set a precedent for the imposition of countervailing duties under the Brussels Convention.

The regular duty under the act of 1897 is 1.95 cents per pound on refined sugar and 1.685 cents on sugar not above No. 16 Dutch standard in color, testing 96° by the polariscope. The rate varies 0.035 cent for each degree above or below 96°, with a minimum limit of 0.95 cent on sugar not above 75°.

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[a] The countervailing duty on German raw sugar was fixed at 26 cents per 100 pounds; on Austro-Hungarian at rates varying for different years from 30 to 20 cents; on French at 80 cents, and on Russian at 63 cents. (Treasury Decisions Nos. 18217, 19071, 21274, 22814, 24167.) Only the last of these duties was retained in force as regards sugar produced after August 31, 1903.

In India after June 6, 1902, Austro-Hungarian and German sugar was subject to special duties of 94 and 83 cents, respectively, per 100 pounds—intended, apparently, to offset the advantage accruing from the cartels.

IMPORTS.

During the last twenty years the domestic sugar production of continental United States was more than trebled, but the imports of sugar also increased rapidly. In 1884, 2,800,000,000 pounds of sugar were imported. In 1904 the imports from all sources, including Hawaii and Porto Rico, amounted to 4,700,000,000 pounds. In that year over 99½ per cent. of the total sugar imports consisted of raw cane sugar.

Table 55 shows the relative importance of several leading sources of our sugar supply. Until the outbreak of war Cuba furnished the main part of the sugar imports of the United States. In the fiscal year 1895 Cuba supplied 52 per cent. of our total imports of raw sugar. The following year imports from Cuba amounted to only 29 per cent., but that island still furnished more sugar than any other country. In 1897 Germany was the leading source of supply, and during the next three years the Dutch East Indies. Nearly all of the imports from that group were furnished by Java. The partial recovery of the Cuban industry brought the imports from that source again to the first rank in 1901. In 1904 Cuba furnished 59 per cent .of the total sugar imports. Sugar imported into the United States from Hawaii increased from 5 per cent. of the total in 1883 to 16 per cent. in 1904.

TABLE 55.—*Percentage of raw sugar imported into the United States from leading countries*, 1883-1904.

Year ending June 30.	From Cuba (cane).	From Dutch East Indies (cane).	From Hawaii (cane).	From Germany (beet).	From other countries.
1883	53.41	0.22	5.35	0.76	40.26
1884	43.23	.23	4.54	2.66	49.34
1885	41.03	.28	6.24	8.55	43.90
1886	45.00	.56	7.12	7.56	39.76
1887	44.47	.56	6.96	7.03	40.98
1888	44.78	.23	8.46	1.91	44.62
1889	37.37	3.11	8.81	7.36	43.35
1890	35.49	3.82	7.65	17.45	35.59
1891	41.12	3.92	8.97	13.19	32.80
1892	56.01	3.98	7.42	4.89	27.70
1893	49.39	4.92	7.73	8.72	29.24
1894	49.64	6.72	7.58	8.27	27.79
1895	52.49	7.98	7.80	8.59	23.14
1896	29.47	15.31	9.50	12.13	33.59
1897	12.21	13.44	9.14	32.02	33.19
1898	17.00	23.75	19.30	5.33	34.62
1899	16.94	25.18	11.80	16.72	29.36
1900	17.61	29.01	12.60	14.70	26.08
1901	23.42	16.58	14.72	14.70	30.58
1902	25.60	16.56	18.74	5.27	33.83
1903	46.40	17.27	15.01	1.45	19.87
1904	59.02	9.19	15.74	.05	16.00

DOMESTIC SUGAR INDUSTRY.

The domestic cane-sugar and beet-sugar industries of the United States now produce about one billion pounds of sugar annually. Of this, about 40 per cent. during the three years 1901-2 to 1903-4 consisted of beet sugar and 60 per cent. of cane sugar.

LOCALIZATION OF CANE AND BEET CULTURE.

The sugar industry of Louisiana is located almost entirely in the southern third of the State. The cane lands, consisting mainly of rich alluvial soil, follow the course of the Mississippi river and also extend westward, including the low, rich lands of St. Mary and Terrebonne parishes. In the parish of Terrebonne more than one-half of the entire area of improved land was devoted to sugar cane in 1899, and in St. Mary 48 per cent. of the improved land. In seven other parishes sugar cane occupied more than one-fourth of the improved land. These percentages bring out very clearly the extent to which southern Louisiana is occupied in cane cultivation.

Beet culture in the United States has been rapidly extended during the last decade. In 1899, 110,000 acres were devoted to beets, and in many sections the importance of the crop was considerable. In Eddy County, New Mexico, nearly 15 per cent. of the improved farm land was devoted to beet sulture, and in Bay County, Michigan, about 13 per cent. Beets occupied more than 6 per cent. of the improved land in Ventura County, California, and in Spokane County, Washington. Since 1899 the beet area of the United States has more than doubled, reaching 292,000 acres in 1903.

ACREAGE AND PRODUCTION OF SUGAR CANE.

Prior to 1899 the census failed to show the amount of cane harvested. Its statistics were confined to the area of the crop and the sugar production.

Statistics for the Twelfth Census show a total area of 387,000 acres devoted to cane culture, of which 277,000 acres were located in Louisiana. The cane harvested in the whole United States amounted to 4,000,000 short tons, of which 3,000,000 were grown in Louisiana. The returns indicate an average yield of somewhat less than 11 tons per acre for the whole United States and about 11⅓ tons for Louisiana. The cane sold brought an average price of $3.40 per ton for Louisiana and $3.45 for the entire country. (See Table 56.)

TABLE 56.—*Acreage and production of sugar cane in the United States*[a] *in 1879, 1889, and 1899.*

State or Territory.	1879. area.	1889. area.	1899. Area.	1899. Cane harvested.	1899. Average yield per acre.	1899. Average farm value per ton.
	Acres.	*Acres.*	*Acres.*	*Short tons.*	*Short tons.*	*Dollars.*
Louisiana	181,592	193,694	276,966	3,137,338	11.33	3.40
Georgia	15,053	20,238	26,056	284,410	10.92	3.86
Alabama	6,627	19,415	32,871	267,857	8.15	3.82
Texas	10,224	16,284	17,824	170,485	9.56	4.02
Florida	7,938	9,345	13,800	140,729	10.20	4.49
Mississippi	4,555	12,694	11,552	122,384	10.59	4.04
S. Carolina	1,787	3,305	7,342	73,702	10.04	3.79
Arkansas	.....	......	460	4,097	8.91	3.25
Indian Territory	.....	......	35	550	15.71	3.87
Arizona	.....	......	50	240	4.80	6.20
New Mexico	.....	......	5	211	42.20	3.69
N. Carolina	.....	......	25	199	7.96	4.91
Total	227,776	274,975	386,986	4,202,202	10.86	3.45

[a]Exclusive of Hawaii.

CANE SUGAR PRODUCTION.

The last three censuses show a regular increase in the production of cane sugar in the United States. The total production in 1879-80 was 215,000,000 pounds; in 1899-90, 301,-000,000 pounds; and in 1899-1900, 323,000,000 pounds. The figures for the last year fail to show the real progress of the industry. The crop of 1899 was much below the average. In Louisiana alone the sugar production of 1899-1900 fell more than 200,000,000 pounds below the production of the preceding year, and in Texas was less than one-fourth of the output for 1898-99.

Outside of Louisiana the production of sugar as compared with sirup is small. With the change from open-kettle to vacuum-pan production, the quality of the by-product—molasses—has greatly deteriorated on account of the much larger extraction of saccharine matter in the form of sugar. This change has opened up a field for the direct reduction of sugar cane to sirup.

Practically one-third of the entire cane harvested in Louisiana and in the other southern States must be reserved for planting. Only two-thirds of the crop is consequently available for sugar making.

BEET SUGAR INDUSTRY.

The beet sugar industry is of recent introduction into the United States. In no year prior to 1891-92 did the total output of beet sugar in the United States amount to as much as 10,000,000 pounds. Ten years later the production reached 365,000,000 pounds, and in 1903-4, 466,000,000 pounds. (See Table 59.[a]) During the last twelve years the beet-sugar output increased to nearly forty times its amount in 1891-92. The industry was first introduced into California. Nebraska and Utah were the next States to take up the production of beet sugar. Beet culture was not introduced into Michigan until 1898-99. In 1903-4, 53 factories, located in 12 States, were in operation. These factories worked 2,023,000 short tons of beets, grown on 292,000 acres. Michigan contributed the largest crop of beets, although California produced the largest quantity of sugar.

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[a]Statistics for 1891-92 to 1893-94 compiled from the Reports of the Commissioner of Internal Revenue; for 1897-98, from Special Report of the Department of Agriculture; for 1899-1900, from the Twelfth Census; for other years, from Willett & Gray, March 2, May 25, July 6, 1899; March 22, June 14, 1900; March 7, 1901; March 27, 1902; March 26, 1903; March 24, 1904.

TABLE 59.—*Production of beet sugar in the United States, 1891-92 to 1903-4.*

Factory year.	Factories. *No.*	Area. *Acres.*	Beets used. *Short tons.*	Average yield per acre. *Short tons.*	Sugar produced.[a] *Pounds.*	Average extraction of raw sugar. Per ton of beets. *Pounds.*	Per cent of beets.	Per acre. *Pounds.*
1891-92	6	7,155	72,530	10.14	12,044,838	184	9.20	1,864
1892-93	6	13,128	128,887	9.82	27,083,288	233	11.67	2,292
1893-94	6	19,645	195,896	9.97	45,191,296	256	12.82	2,556
1894-95	5	19,538	(b)	(b)	45,006,000	(b)	(b)	2,559
1895-96	6	22,948	(b)	(b)	65,453,000	(b)	(b)	3,169
1896-97	7	57,239	(b)	(b)	84,081,000	(b)	(b)	1,632
1897-98	9	41,272	389,635	9.44	90,491,670	258	12.90	2,436
1898-99	15	37,400	(b)	(b)	72,735,000	(b)	(b)	2,161
1899-1900	31	135,305	794,658	5.87	163,458,075	229	11.43	1,342
1900-1901	34	132,000	811,654	6.15	172,164,000	236	11.78	1,449
1901-2	39	194,725	1,704,595	8.75	365,402,000	238	11.91	2,085
1902 3	44	259,513	1,888,665	7.28	437,837,000	258	12.88	1,875
1903-4	53	292,295	2,022,839	6.92	466,222,000	256	12.80	1,772

[a]The bulk of the sugar produced is refined. For calculating the average extraction the figures here given have been reduced to terms of raw sugar on the assumption that 90 pounds of refined is equivalent to 100 pounds of raw.

[b]Not stated.

The average yield of beets per acre in the United States was about 7 short tons. In Utah, where the crop was grown almost exclusively under irrigation, the average yield was 10½ short tons per acre, and in California nearly 9 short tons. For the country as a whole, the average yield of beets per acre apparently shows a decline since 1891-92. This is due to the introduction of beet culture into States where the methods of culture are less intensive than those in California. In 1891-92, when the average yield per acre was 10 short tons, more than two-thirds of the entire sugar output was produced in California. While there has been some decrease in the average yield of beets per acre, there has been a noticeable improvement in the average sugar extraction. In 1891-92 the average extraction was 9.20 per cent.; in 1903-4, 12.80 per cent. In California the average extraction was considerably higher—13.86 per cent. of the beets worked in 1903-4. (See Table 60.[a])

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[a]Willett & Gray, March 24, 1904.

TABLE No. 60.—*Production of beet sugar in the United States, 1903-4, by States.*

States.	Factories. *No.*	Area. *Acres.*	Beets used. *Short tons.*	Average yield per acre. *Short tons.*	Sugar produced. *Pounds.*	Average extraction of raw sugar. Per ton of beets. *Pounds.*	Per cent of beets.	Per acre. *Pounds.*
California	7	62,195	544,251	8.75	135,762,000	277	13.86	2,425
Michigan	20	117,100	581,059	4.96	127,823,000	244	12.22	1,213
Colorado	8	52,300	410,414	7.85	88,628,000	240	12.00	1,883
Utah	7	18,700	195,810	10.47	46,301,000	263	13.14	2,751
Nebraska	3	11,400	76,642	6.72	19,418,000	282	14.08	1,893
Wisconsin	1	5,800	51,000	8.79	11,001,000	240	11.98	2,107
New York	2	7,000	45,130	6.45	10,033,000	247	12.35	1,593
Idaho	1	5,300	38,001	7.17	7,999,000	234	11.69	1,677
Minnesota	1	3,800	30,000	7.89	7,000,000	259	12.96	2,047
Washington	1	4,400	22,177	5.04	4,957,000	248	12.42	1,252
Ohio	1	2,500	17,000	6.80	4,500,000	294	14.71	2,000
Oregon	1	1,800	11,355	6.31	2,800,000	274	13.70	1,728
Total	53	292,295	2,022,839	6.92	466,222,000	256	12.80	1,772

SUGAR SITUATION IN 1904.

The continental beet sugar industry enjoyed government aid for so many years that the question naturally arises, Will the industry be seriously impaired by the recent withdrawal of bounties? Considerable time must necessarily elapse before a definite answer can be given.

Under the restrictions and bounties of the past, admirable methods of culture and of extraction were developed. The freer competition of the present will show whether the improved methods evolved are sufficient to offset whatever peculiar natural advantages the Tropics possess.

The most obvious effects of the sugar legislation prior to the Brussels Convention were undoubtedly the artifically high prices obtained in the countries of production and the artificially low prices prevailing in foreign markets. While the average price of refined sugar during the year ending August 31, 1903, was less than 4 cents per pound in the United Kingdom, and only 4½ cents per pound in the United States, the price in the continental sugar-producing countries varied from 6¼ cents per pound in Germany to over 8 cents per pound in France. But at the same time that the German consumer of sugar was thus paying over 6 cents per pound for his supplies German refined sugar when shipped abroad brought the exporter only 2 cents. Of necessity the exports were increasing with far greater rapidity than the domestic consumption.

The Brussels Convention materially altered the situation. The bounties, which were partly responsible for the low export prices, were abolished, and in several cases the excise was considerably reduced, although no change in the strictly internal regulations was required by the convention.

In consequence domestic prices were considerably lowered and export prices slightly raised. Sugar now brings only about 4 cents per pound in Germany, 5 cents in France, and 6 cents in Austria. The reduction in domestic prices was in some cases greater than the decrease in the excise. Higher prices had been obtained partly by the action of strong national combinations of sugar producers. In Austria-Hungary, with no reduction whatever in the excise, prices fell fully 1½ cents per pound when the cartel was dissolved.

While Russia was not a party to the Brussels Convention, its sugar legislation was also considerably modified in 1903. Previously the effect of the Russian law was to encourage exportation by apportioning privileges in the domestic market according to total output. By amending this provision, the special incentive to producing for shipment abroad was lessened. The signatory powers, as well as the United States and British India, now impose a special countervailing duty on

Russian sugar imported, while the United Kingdom entirely prohibits its importation.

The overproduction of previous years and the accumulation of enormous stocks rendered much more difficult the transition to the new conditions required by the convention. The acreage of sugar beets in Europe was materially decreased, and an unsuccessful attempt was made to restrict production through a voluntary agreement between the sugar producers of various countries. The transition was effected with little or no increase in sugar stocks.

Production for the home market will undoubtedly become relatively more important. Even under the Brussels Convention a protective surtax of half a cent per pound may be placed on imported sugar. The lower inland prices that now prevail will encourage increased domestic consumption, while the abolition of export bounties takes away one incentive to excessive shipments abroad. Exportation will nevertheless continue on a large scale; for it will doubtless be more profitable to sell part of the output abroad, even at lower prices, than to limit production strictly to local requirements. But legislative aid will no longer recoup producers, if by excessive output world prices are reduced more than the expenses of production.

The relative increase in local consumption as compared with shipment abroad is clearly indicated in Table 61.[a] During

TABLE 61.—*Sugar production, consumption, and exports of Germany, Austria-Hungary, and France for the twelve months ending August 31, 1903 and 1904.*

Country	Production.	Consumption.[a]	Exports.[a]
	Pounds.[b]	*Pounds.*[b]	*Pounds.*[b]
Germany:			
1902-3	3,869,947,600	1,631,484,900	2,328,977,100
1903-4	4,253,588,100	2,478,160,200	1,946,264,100
Austria-Hungary:			
1902-3	2,303,344,000	841,879,000	1,743,035,500
1903-4	2,545,411,000	1,109,632,000	1,364,404,700
France:			
1902-3	1,815,812,000	909,076,000	513,725,000
1903-4	1,751,401,000	1,712,313,000	574,018,000

[a]Compiled from Monatliche Nachweise über den auswärtigen Handel des deutschen Zollgebeits, Statistische Uebersichten betreffend den auswärtigen Handel des österreichisch-ungarischen Zollgebiets, Statistik des auswärtigen Handels des österr-ungar. Zollgebiets, Documents statistiques sur le commerce de la France, and Deutsche Zuckerindustrie, 1904, pp. 1557-1558, statistical part, p. 521, Journal des fabricants de sucre, September 21, 1904.

[a]The combined consumption and exports may exceed the total production for any year by the imports and the decrease in stocks.

[b]In terms of raw sugar.

1903-4, the first year after the Brussels Convention went into effect, 58 per cent. of the sugar output of Germany was consumed within the Empire, while during the preceding year only 42 per cent. was consumed locally. On the other hand, the proportion of the output exported decreased from 60 per cent. in 1902-3 to 46 per cent. in 1903-4. In France large colonial receipts, together with accumulated stocks, made it possible for the exports to increase notwithstanding an enlarged domestic demand almost equal to the entire domestic output. The statistics given may slightly exaggerate the real increase in consumption and decline in exportation, for the anticipated changes in legislation on September 1, 1903, encouraged producers to delay entering sugar for consumption until after that date and to clear sugar for exportation before that date.

More equal conditions of competition in the world's market between beet and cane sugar and increased consumption of sugar in continental Europe appear to be the most important features in the present sugar situation.

The new sugar year opens with prospects for a reduced beet sugar output in Europe that will probably wipe out the accumulated stocks and perhaps necessitate a considerable decline in consumption. General drought throughout the beet-growing sections, together with a reduction of 7 per cent. in the plantings, caused a falling off in the beet crop estimated at 20 per cent. as compared with 1903.[a] The International Association for Sugar Statistics estimates the beet-sugar production of Europe for 1904-5 at only 4,450,000 long tons—less than that for any other year since 1895-6. Such an estimate, based on returns from manufacturers, doubtless somewhat exaggerates the decline. Licht's estimate is considerably higher—4,870,000 long tons for 1904-5, as compared with 5,770,000 long tons for 1904, a decrease of 900,000 long tons, or over 15 per cent. An increase in the cane sugar production estimated at 400,000 long tons will partly offset this decline, and, if fully realized, will raise the share of cane sugar in the commercial sugar production of the world from 42 per cent. in 1903-4 to about 48 per cent. in 1904-5. If the actual decline in the European output is as large as that anticipated, the consequent high prices may check the increasing per capita consumption of sugar. Still, such an effect can scarcely prove permanent, for high prices resulting from a bad crop are not only temporary but constitute an incentive to larger crops and hence lower prices in the future.

Perhaps the chief objection to the abolition of bounties was

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[a]Deutsche Zuckerindustrie, 1904, p. 1830; Journal des fabricants de sucre, November 2 and 9, 1904; Willett & Gray, November 23, 1904.

the difficulty anticipated in marketing the accumulated stocks and the production above domestic requirements. For the year 1904-5, at least, this difficulty will be removed, and in the future, with no special incentive to production for shipment abroad, it will doubtless prove more feasible than in the past to accommodate the output to the actual demand.

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*THE INSPECTION AND DISINFECTION OF CANE CUTTINGS.**

By N. A. Cobb.

PICKLING THE CUTTINGS.

[Continued from February No., page 72.]

Having used every care that the sets are as free from disease as it is possible to get them, the next step is to treat them in such a way as to arm them against any possible future attack. This may be done by treating them with one of a number of substances inimical to fungus life. Here we enter upon a more or less debatable field. It is known that a number of these treatments are useful so far as preventing disease is concerned, but it is yet a question how far and under what conditions they can be applied with profit. Various preparations have been proposed and tried. Among these are tar, Bordeaux Mixture, lime-water, weak solutions of carbolic acid, and formalin. Of all these the most promising, it seems to me, is Bordeaux Mixture, but the strength to use, and the time of soaking, if the soaking method be employed, and the apparatus that should be employed on a plantation to accomplish the desired end effectually and economically have yet to a considerable extent to be worked out. About all that can be said at present is that the percentage of germination is increased by an amount that justifies considerable expenditure in "pickling." The solution of these questions will engage the attention of the Hawaiian Sugar Planters' Experiment Station during the coming year, and it is hoped that before next planting season, i. e., that of 1906, more definite data will have been procured for the guidance of planters. The facilities of the Station are, however, inadequate for the solution of plantation methods. These must be perfected on the plantations themselves.

*To the tar add half a pint per gallon of spirits or kerosene.

INSPECTION AND PICKLING OF SEED CANE IN OTHER COUNTRIES.

It should be stated that the "pickling" of seed is no new thing. It has been tried with success in various ways. To mention a well known case we may cite the treatment of onion seed with fungicides for the prevention of the onion diseases known as smut. This disease is of fungus origin. Potatoes are successfully pickled in a fungicide for the prevention of scab. Various cereal grains are pickled in formalin and other fungicides for the prevention of a number of different fungus diseases. In all these cases the saving effected through the pickling of the seed is very great ,and the practice is a regular part of the farmer's work every year in many parts of the world.

That the "seed" of cane is no true seed in no way affects the comparison that may be instituted between the various cases mentioned and the planting of cane. Broadly, the cases are comparable. As in the instance mentioned, so in cane, the disease gains entrance to the new plants through the part planted, be it the seed as in the case of wheat or oats, or a tuber, as in the case of potatoes. It is no wonder then that as soon as scientists proved that disease does enter the cane plant per medium of the "seed," they soon began to devise methods of treating the "seed cane."

Experiments have been carried out in various parts of the world in the inspection and treatment, i. e. "pickling" of seed cane; in the West Indies, in Australia, in Java, and in Hawaii, to come nearer home. In all cases the treatment has been reported on as more or less successful, and in some regions it has been carried out successfully on a plantation scale and year by year the practice is increasing.

Early in 1894 the author devised an inspection scheme for the Gumming Disease of Cane as it occurred in New South Wales. This inspection method was adopted with entire success, the amount of disease of that nature being immediately reduced from one of alarming proportions to a loss that was little complained of.

In Queensland, cuttings are sometimes dipped in weak carbolic acid. In other countries the seed cane is merely soaked in water, the object being among other things, to reduce the saccharine matter at the end of the cuttings, as it is this that attracts and supports the fungus while it is ferreting its way into the new plant. This practice also prevails in the Island of Hawaii.

In the West Indies the cuttings are tarred* at the ends in order to secure these raw parts from the attacks of injurious fungi. Latterly experiments have been made there with Bordeaux Mixture, the seed being pickled in full strength mixture for from two to twenty-four hours. Sometimes the pickling with Bordeaux Mixture is combined with tarring the ends of the cuttings. So far as I have been able to learn, this practice while gaining in favor is not yet wide spread.

In a press bulletin issued from this Station April 7th, 1904, Mr. R. C. L. Perkins, Director of the Division of Entomology, called attention in the following words to the advisability of soaking cane cuttings:

"At the present time, it is advisable that all seed cane should be soaked in a bath of one pint of carbolic acid to 100 gallons of water shortly before planting."

Finally in Hawaii Mr. C. F. Eckart, Director of the Agricultural and Chemical Division of this Experiment Station has made trials of treatment with Bordeaux Mixture, upon which he reports, under date of August 16th, 1904, as follows:

PLANTING EXPERIMENTS WITH TREATED AND UNTREATED CUTTINGS.

"On July 27th a number of Lahaina cuttings (each having three eyes) were well mixed and divided into two lots of 100 cuttings each.

"One lot was soaked in Bordeaux Mixture for 12 hours, after which the ends were tarred and the cuttings planted in a row 105 feet long. The other lot was immersed in water for 12 hours and planted in a row adjoining the first lot. One week after the first two lots of cuttings were planted, it was decided to plant a third lot which had received no treatment at all, these last cuttings to furnish the basis for comparison as regards germination rather than the lot which had been soaked in water. The experiments were then numbered as follows:

No. 1. Untreated cuttings.

No. 2. Cuttings soaked in water for 12 hours.

No. 3. Cuttings soaked in Bordeaux Mixture for 12 hours and the ends dipped in tar.

While Nos. 2 and 3 are strictly comparable, having been planted at the same time, No. 1, as has been stated, was planted one week later, which necessitated the final count of shoots being made one week later than in the other tests. Considering the time of year at which these cuttings were placed in the ground, it may be safely assumed that the data obtained from row No. 1 are about as valuable for purposes of comparison as would have been the case had this test started off at exactly the same time as the others.

The three rows were irrigated with one inch of water per week and the following counts were made of the germinating eyes:

Date.	No. 1.	No. 2.	No. 3.
August 17th	6	133	108
August 24th	39	158	157
August 27th	61	163	167
September 6th	110	180	196
September 13th	136	187	201
September 20th	139	190	205
September 27th	143	190	208
October 4th	145	...	...

Two months after planting the tests were concluded and furnished the following data:

	No. 1.	No. 2.	No. 3.
Number of eyes germinated	145	190	208
Number of eyes alive but not germinated	18	10	18
Number of eyes dead	137	100	74
Number of cuttings with all eyes dead	10	4	2

The Bordeaux Mixture employed in this experiment contained 6 pounds copper sulphate and 4 pounds of lime in 50 gallons of water."

It will be seen that Mr. Eckart's report given above is favorable to the use of Bordeaux Mixture.

As it seems probable that the preparation and use of the Bordeaux Mixture will be a novel matter on most sugar plantations, the subject may as well be treated somewhat in full.

Bordeaux Mixture, so named from the city in France near which it was first successfully applied, is a compound made by mixing lime-water and a solution of sulphate of copper. The original strong formula was as follows:

Sulphate of copper: 6 lbs. in one gallon of water.

Lime: (fresh and "quick") 3 lbs. in one gallon of water.

Dilute the latter to 20 gallons and add the copper sulphate with stirring. This formula is not much used nowadays.

The above formula was found to be too strong for some purposes and has been replaced for most purposes by the following weak formula:

Sulphate of copper, 6 lbs.

Lime, 4 lbs.

Water, 50 gallons.

This latter mixture is very largely employed as a fungicide, being applied to the surfaces of plants with special spraying apparatus invented for the purpose and to be had of all first class hardware dealers throughout the world.

Though this weak formula has been found too strong for some plants, there are numerous cultivated crops that may be benefitted by its application if actually attacked by a fungus disease. Some plants easily withstand the stronger mixture.

This much has been said on the general subject of Bordeaux Mixture by way of introduction.

It is now necessary to specially emphasize the fact that when this mixture is used to ward off disease from tubers, etc., planted in the soil it is found that the strong formula is the better as a rule, and it is to be supposed from the nature of cane cuttings that they will stand even stronger mixture than the above strong formula. It will be perfectly safe, at any rate, to use the strong formula.

The following extracts from the various writings of the author will give a good idea of the method of preparing Bordeaux Mixture. It must be used while fresh.

"PREPARATION AND USE OF THE BORDEAUX MIXTURE."*

I. Preparation.

"Where the Bordeaux Mixture is in rather constant use it is a very good plan to keep its two constituent parts in solution, so as to be able to make fresh mixtures expeditiously whenever required. The following suggestions will be helpful to this end:

"Sulphate of Copper Solution.—Fill a wooden upended cask nearly full of water, putting in (say) 40 gallons of water. Hang in this cask, just under the surface of the water, 8 lbs. of sulphate of copper, done up in a piece of sacking. On the morrow the copper sulphate will be found to have dissolved, so that each five gallons of the water, on stirring will contain 1 lb. of copper sulphate. Cover it well, and mark the inside of the cask where the surface of the solution stands, so that if, when the cask is next examined, the solution has somewhat evaporated, the requisite amount of water can be added to make up the deficiency. This is a stock solution to be kept on hand, from which to make mixtures as required.

"Whitewash.—If quicklime be kept long in stock it 'airslakes,' and this is undesirable, because the whitewash made from partly slaked lime is inferior. Adopt, therefore, the mason's plan of slaking a large bulk of lime and keeping the whitewash in stock. Slake the lime in the usual way while it is still all good, i. e., freshly burned and "quick." Make a rather thick whitewash, of smooth consistency, free from lumps. Store this in an iron tank or large cask. As soon as it is poured in it begins to settle, and in a day or two the top part will be found to be quite clear. If the tank or cask be kept covered, this subsided whitewash can be kept for some time, especially if a few drops of oil are used to form a film on the surface. Evaporation may take place and the defici-

* "Letters on the Diseases of Plants." Sydney, 1897.

ency thus created must be supplied by adding water from time to time. This is the second stock solution from which to make mixtures as required.

"With regard to the first of these stock solutions, the copper sulphate solution, I would remark that it is a matter of no particular consequence how much copper sulphate is dissolved so long as the amount is known. Thus if the orchardist prefers to make a stronger solution by dissolving 40 lbs. of copper sulphate in 40 gallons of water, there is not the slightest objection, in fact there is some advantage, inasmuch as the solution will occupy a smaller space for a given quantity of the copper sulphate. The main point is to know how much by weight of the coppér sulphate there is in each gallon of the stock solution when it is made.

"Bordeaux Mixture.—To make up a mixture from the two stock solutions proceed as follows: First decide what strength of Bordeaux Mixture is to be made. Suppose it is decided to make a mixture that shall contain 3 lbs. of copper sulphate to each 40 gallons of mixture, and the stock solution of bluestone contains 1 lb. of bluestone in each gallon of water. Take 3 gallons of the stock solution of bluestone (which of course will contain 3 pounds of the sulphate) and dilute it to about 20 gallons. Stir up the settled whitewash with a paddle until a smooth thick whitewash can be dipped out. Dilute this with water, making sure, however, not to dilute it so much that more than about 10 gallons will be required to combine with or neutralize the 20 gallons of copper sulphate solution. This is something that has to be learned by practice, but it is easily learned. Strain the whitewash if necessary, in order to remove lumps, but it ought not to be necessary. Now add the whitewash slowly to the sulphate solution until the latter is neutralized, which can easily be ascertained by testing the mixture with a solution of ferrocyanide of potassium, a yellow crystalline salt to be had of any druggist. Buy ten cents worth—it will last a long time. Dissolve the ten cents worth of ferrocyanide of potassium in a tumbler of water and place it in a bottle. It will keep; be careful with it, however, as it is very poisonous if taken internally. The solution, if properly made, will be light straw-colored.

"To test the Bordeaux Mixture so as to find out when sufficient lime has been added to the 10 gallons of copper sulphate solution, take a drop of the Mixture on your finger and dab it on to a board, or better, a bit of white paper, and add a drop of the ferrocyanide solution with a finger of the other hand. If you have not added sufficient whitewash, the ferrocyanide will produce at once a red color. Keep adding whitewash until the ferrocyanide just fails to produce at once or after a few moments a decided red color. When that point is reached the copper sulphate is exactly saturated and neutralized by the lime of the whitewash. This is a better test than sticking in a knife-blade—quicker and more decisive, and more accurate.

"When the copper sulphate is just saturated you have a choice of adding more lime or not. In my opinion, for many purposes it is desirable to add as much lime again as has been added to secure the above test. But the addition of too much lime is not desirable because you may by this means so dilute or cover up the copper compound as to render it ineffective.

"It will be seen that in saturating the copper sulphate solution with whitewash, it is necessary to keep note of how much whitewash is added. This is done by the use of a quart measure. If no account is kept it will be impossible to tell how much additional whitewash to add should it be thought desirable to add any.

"The knife-blade test referred to above consists in thrusting a clean, freshly scoured knife-blade or other piece of polished iron or steel into the mixture that is being made. If a deposit of copper forms on the iron after a minute or two, the sulphate of copper is not yet neutralized and more whitewash needs to be added. This test is by no means so sure, or quick, or accurate as that with ferrocyanide of potassium, but it has the advantage of being nearly always readily applied.

"Should too much whitewash be by accident added, so that on the first trial neither of the above tests (copper on the knife-blade or red color with the ferrocyanide) can be secured, either of two methods can be followed:

"1. Throw the mixture away and start again.

"2. Add more copper sulphate solution until a red color just begins to appear.

"In this latter case, however, it will be essential to know just how much extra sulphate solution is added, so as to know how much to make the mixture up to finally.

"It will probably be best for the beginner to begin in a small way, and if he overshoots the test, throw the mixture away, and try again. All the difficulties (and even these are slight) are in learning how; once learned, this method of preparing the mixture is as easy as any—in fact, considerably easier.

"We will suppose, however, that no accident has occurred, so that the 10 gallons of sulphate solution have been properly neutralized with whitewash, and that then as much again whitewash has been added. It now only remains to add water until the whole mixture is made up to 40 gallons, and we have a properly made Bordeaux Mixture containing in every 40 gallons just 3 lbs. of sulphate of copper.

"The advantages of this method of preparing the mixture are:

"1. Expedition. It is the quickest way where the mixture is regularly used and is required from time to time through the season.

"2. It is accurate. It does away with the uncertainty always connected with the strength of commercial quicklime.

"3. It is the most economical way. No lime is wasted.

"4. The resulting mixture will always be the same, and there will be no risk of 'burning' the plants by spraying with a mixture too strong, or wasting time applying a mixture that is too weak to do any good. Both these mistakes are too common, and will account for the failures that are from time to time reported. Bear in mind that there is no doubt about the efficacy of this mixture in the cases where properly qualified persons recommend it. All the failures, and I am glad to say they are comparatively few, arise from ignorance of how to make or apply the mixture.

"5. Finally, the making of the mixture from dilute solutions gives a finer precipitate, which is more easily kept in suspension, and is less liable to clog the nozzle. Perhaps this ought to be made a little plainer. I will therefore put it this way: If 1 lb. of sulphate of copper dissolved in ten gallons of water, be neutralized by 1 lb. of quicklime in ten gallons of water, the precipitate will be finer than if 1 lb. of sulphate of copper dissolved in one gallon of water be neutralized with 1 lb. of quicklime slacked in one gallon of water—even though afterwards the latter mixture be made up to 20 gallons, which is the same bulk as the first when finished; and, of course, if the precipitate is finer it will give correspondingly less difficulty in the application."

PREPARATION OF BORDEAUX MIXTURE.*

"It is unnecessary to say that the proper preparation of the Bordeaux Mixture is an important matter. I am convinced that a very large amount of improperly prepared mixture is annually used. I do not think that the trees are often injured by such imperfect mixtures, but I am sure that money is wasted in their use, and that some discouragements to growers follow, together with disparaging remarks with reference to spraying in general. I am naturally proud, as one of those mainly responsible for the introduction into this country of modern spraying on a commercial scale, of the rapid progress the method has made; but at the same time I am sorry to know that at this late date there are still orchards minus a spraying outfit, and orchardists that neglect this method of easily adding to their profits. This I attribute in some degree to the use of improperly prepared mixtures. Bordeaux Mix-

* "Letters on the Diseases of Plants." Sydney, 1904.

ture is one of the most important of the mixtures applied in the form of a spray, and a word about this important matter is hardly ever out of place.

"The materials should be pure. They are easily procured in a state of purity. In particular, the lime should be quite fresh and 'quick.' It should be quite free from what is called air-slacking, i. e., it should have been so kept in tight receptacles that it has not absorbed, and combined with, moisture in the air.

"In making the milk of lime, the aim should be, of course, to have it as smooth as possible. To secure this result, water should be added sparingly until the lime is completely slacked. The lime should not be deluged with water. Hot water may be used, often with advantage, especially at the outset. If too little water is added the lime will become overheated, and this is an objection. Water should be added fast enough to prevent this overheating. The aim should be to produce a very thick and smooth paste, which when it is afterwards diluted with water will be perfectly free from lumps or granulation. A good plan for the novice is to try a small portion of lime at first, and from the lesson thus learned to go on to the larger matter of preparing his mixture. The thick paste should be watered gradually, and not all at once. As most lime contains lumps that will not slack, it is often necessary to strain the milk of lime after it is prepared, and before it is added to the sulphate of copper solution.

"It is far better to mix the two solutions in a dilute form than to mix them in a concentrated form and afterwards dilute them. The milk of lime should be run very gradually into the copper sulphate solution, and the two liquors as they are mixed should be constantly agitated. This results in a superior mixture.

"This superiority has been well illustrated in an article by Professor McAlpine of Victoria, and I have secured from the Department of Agriculture, through the courtesy of the Minister, the use of the blocks so forcibly illustrating the non-settling properties of the properly made mixture.

"It will be seen on examining the illustrations that the mixture was prepared in three different ways, and each of the three resulting mixtures was placed in a cylinder and allowed to subside. The mixture that stays in suspension the longest is, of course, the best, the reason being that it is in the finest state of division, and hence will work through the spray nozzle most freely and act most efficiently after it is applied to the plants.

"The two most technical parts of the process of making Bordeaux Mixture are the preparation of a smooth fine-quality of milk of lime or whitewash, and the mixing of the same with a proper amount of copper sulphate solution.

"Any one who feels uncertain about the former operation should remember that there are numerous skilful preparers of whitewash and that the chance to witness the operation as performed by an expert is easily secured."

From these directions it will be easy to make a Bordeaux Mixture of any desired strength. The strength suggested for experiment at the present time is the strongest of the mixtures mentioned above. As soon as it is definitely ascertained how much, if any, stronger the mixture can be used, the information will be printed in a Station bulletin.

It may be asked why, if the treatment with Bordeaux Mixture is efficient, it is necessary to inspect the cuttings. Why not trust to the action of the Bordeaux Mixture alone? Unfortunately this cannot be done. The benefits of the Bordeaux Mixture are confined to the surface of the plant. It has little or no power to penetrate into the interior of the plant. Hence any fungus disease that is already in the tissues of the plant is beyond the reach of this fungicide. Fungus mycelium in the cane cutting cannot be hindered in any known way from entering the tissues of the new plant by way of the sap vessels, etc., which pass from the cutting into the bud, and hence into the new plant. The Bordeaux Mixture cannot prevent this *internal* transmission of disease. Its only power is to prevent the growth or germination of spores and mycelium on the *surface* of the cuttings. All these statements are statements of facts that have been established by numerous investigators, and they are the foundation facts of the present world-wide use of this Mixture.

"PICKLING" ON A PLANTATION SCALE.

Five different plans present themselves for the carrying out of this work on the plantations.

1. The treatment may be regarded as too uncertain in its results to be looked at as anything more than an experiment, to be carried out on a comparatively small scale, and with as little expense as possible. This view I consider to err on the side of too great caution. The benefits of "pickling" are too well established to admit of doubt, and in my opinion the main thing to consider in Hawaii is the particular plan by which the pickling can be most economically accomplished. It cannot be denied that outfits adapted to treating five to ten thousand tons of seed per season of two months have never been devised, and a certain amount of caution should accompany the sinking of capital in such an outfit. This leads us to the remaining four plans that seem to exhaust the list.

2. The seed may be treated in wooden tanks of suitable capacity, about one truck load of seed per charge, so placed between two tracks that they can be conveniently filled from

trucks on one track and emptied into trucks on the other track. The transference of the cuttings is accomplished by the aid of gravity, so that one of the tracks would have to be some 15 to 20 feet above the other on a steep embankment or on trestle-work. In this case it would be best to swing the wooden tanks on pivots to facilitate emptying. The tanks should also be provided with a large faucet at the bottom.

3. The seed may be treated in fixed wooden tanks so located with reference to the trucks that by means of a derrick and a net of tarred rope the cuttings can be transferred from one to the other. Rope three-eighths of an inch in diameter woven into meshes two and one-half inches across, will hold the cuttings, and possibly a larger mesh would answer. Tarred rope will be more resistant to the action of the Bordeaux Mixture than ordinary rope. At some mills the railway unloading derricks could easily be adapted to this method of handling the cuttings.

4. The cuttings may be treated in special trucks adapted to the transportation of liquids, but these trucks must not be of steel, or if constructed of steel must be lined and otherwise protected from the action of the Bodeaux Mixture. This may be accomplished by lining the trucks with wood so as practically to convert them into wooden tanks.

5. The cuttings, handled on special carriers, may be passed on the same through the pickling solution, in somewhat the same manner that prunes are dipped by machinery in alkaline solutions.

From a purely engineering point of view, it would seem that No. 4 has many advantages. It would require the least machinery and have other important advantages. For instance, the treatment could be carried out at any desired point on the plantation, there being no part of the outfit that is not portable. This would save a good deal of transportation of cuttings. The trucks should be of the tipping type.

Which of these methods is to be preferred on a given plantation must be determined by the circumstances of the plantation, i. e., the general system on which the plantation is conducted, how much seed has to be treated, what machinery is already available in the shape of trucks, derricks, etc., etc.

Plan No. 2 I am assured would be feasible on some plantations. I have noticed at some plantations that redwood tanks are used for the storage of molasses. These tanks are suitable for dipping cuttings in Bordeaux Mixture. If some of these of suitable capacity could be swung on pivots near the railway in some convenient location, it would be possible to rig a loading and unloading arrangement that would be practical. If a side track could be laid from which the cuttings could be dumped into the tank of Bordeaux and the tank be high enough above the main track to allow of empting the treated cuttings into trucks on the main track, the arrangement would be convenient.

THE BUSINESS ASPECT.

In these pages we have outlined the various methods that may be applied to the selection of cuttings of cane when it is necessary to combat the effects of disease. The principal question now arises, which of them are applicable in any given case. The answer to this question can be given with precision only by the manager of the plantation after he has obtained the opinion of his experts. He must estimate his losses and prospective losses, and balance against these the probable expenditure and the probable benefit of the inspection or pickling, or both.

In general it may be said, that certain of these precautions are to be recommended under all ordinary conditions. I can conceive, it is true, of a case where all such precautions would be superfluous, but I have never yet seen such a case. The use of the best portions of the crop for "seed" would seem to be too obvious a precaution to require comment. The field inspection that results in cancelling for "seed" certain suspicious patches and plants will in almost all cases, in my opinion, be a paying operation. Furthermore there are comparatively few plantations where the detailed inspection of the cuttings would not be a paying operation. When it comes to the treatment with Bordeaux Mixture, all that can be said is that on those plantations where there is much loss from disease, the managers should lose no time in conducting experiments at least on a limited plantation scale. All the facilities of the Hawaiian Sugar Planters' Experiment Station are at the command of planters in connection with any such field experiments. The area of the Station grounds is altogether inadequate to such work, though many instructive and useful details can be, and it is hoped will be, worked out there.

There is one point that I have seldom found sufficiently realized, namely, that the losses from disease have to be subtracted from the margin of profit, within the limits of successful remedial measures. It takes just as much land, energy, and trouble to raise a diseased plant or crop as it does a healthy one. There is no doubt that at the present time science is far ahead of practice, however much it may be behind our desires. There are remedies at hand that may be applied by every planter who has the energy and intelligence to learn and practice them. Every cent so saved augments the profits. I am sure, however, that there is little need in Hawaii to preach such elementary finance as this.

ACCUMULATION OF DISEASE.

In the case of a crop grown as is cane in Hawaii, namely in continuous succession on the same land for a long series of years, it is highly desirable to be specially careful on the score of disease. It would be always best under such conditions to endeavor to "keep on the safe side" even at some considerable expense. This is a matter of such grave importance, and one so little understood even among experts, that it seems well to dwell upon it at some length.

The history of Agriculture, like most other history, is a history of improvements—improvements due to new discoveries and to the overthrow of errors that arose through incorrect reasoning and observation. It does not seem to me to be at all derogatory to the chemical side of agriculture to point out that the early and most important discoveries in connection with the chemistry of the soil were in many cases misinterpreted owing to the lack of definite information as to the facts of plant physilogy and pathology. In the hands of Liebig and his successors chemistry was made to do untold good in advancing agriculture. It may be easily doubted, however, whether in some instances the chemical view of agricultural problems has been broad enough for our best interests. Too little attention has been given to the fact that in the production of crops plants are, after all, the main factor.

If we study the subject of rotation of crops we find the reasoning to be largely chemical. It is said that one crop, having certain requirements, leaves the soil more or less exhausted of certain ingredients and hence this crop should be followed by certain others whose needs are different and fit in with the chemical requirements of the case. In general no one will venture to combat this reasoning, taken in a broad way. But it by no means presents the whole of the case. It leaves out of consideration a most important set of facts. These we will now endeavor to present in a clear manner.

When a given variety of plant is grown for years in succession on the same piece of land, as for instance, cane is grown in Hawaii, the diseases of that crop accumulate on that land This seems too obvious to need proof, and the recent experiences of the Hawaiian planters is such that they certainly need no illustration. A larger and larger number of the diseases of cane have occurred here for some years. This was inevitable. There is no known way of absolutely preventing such an accumulation, though we may delay it by proper inspection of imports.

Now this inevitable accumulation of the diseases of a crop grown year after year on the same land leads to a decrease in the yield. This is a factor in the rotation of crops that has been largely lost sight of—sometimes never thought of. Nevertheless, it is a most important factor, and one that has quite as much to do with the necessity of rotation, in many cases, as the chemical changes in the soil.

If this course of reasoning is correct, and I am convinced it is, it behooves the growers of sugar cane in Hawaii to be specially careful about the accumulation of the diseases of the cane plant on their plantations.

The application of these principles to the selection of cane sets in the method described in these pages would lead to all the greater care in all the details of the processes described. In other words, under the circumstances, it is better to be a little overcautious than not cautious enough.

BUT WE CAN'T DO ALL THIS!

If it be argued that the methods here advised are perfection, and that no such perfection can be attained on the plantation, the reply is that if this degree of perfection cannot be attained, at least an effort can be made in this direction and the work be made to come as near perfection as the profits will warrant.

(Note)

SUPERIORITY OF TOPS AS "SEED."

The opinion prevails in many parts of the world that the tops of the cane furnish the best "seed." This opinion is based on field experiment or on observation. It is of interest to consider that the top of the plant is that portion that is for the most part completely covered by the sheaths of the leaves and on that account, supposing the leaves themselves to be healthy, has been least exposed to the attacks of fungi and insects, so that it is the top nodes that are characterized by the greatest freedom from internal disease. This being the case, may it not be that these joints when used as seed produce better results partly because of this freedom from preinfestation? It is a fact that the top nodes from fairly well grown cane are freest from infestation. The query whether their reputed superiority for cuttings is due to this fact arises in theory.

Plant cane is usually found to be preferable as a source for cuttings. Here again we may possibly have a similar set of facts. It is a fact that as a rule the nodes of plant cane are more free from disease than the nodes of rattoon cane.

Taken altogether it looks as if the reputed superiority of certain phases of cane growth as a source of cuttings is at least in part a function of the degree of fungus infestation.

If this is true, it throws new light on the matter and enables us to assign results to their causes.

CONSTRUCTION OF PIPE LINES.

By W. J. Dyer.

The development of water power under high heads originated on the Pacific Coast of the United States and dates from the cessation of hydraulic gold mining on the western slopes of the Sierra Nevada Mountains in the early eighties.

Prior to that time immense ditches and canals had been constructed, bringing water from the numerous streams, their sources being the snow-clad tops of the Sierras. This water was used under heavy pressures for sluicing the gravel in the rich placers; in fact, whole hill sides could be cheaply moved by this means.

However, the vast volume of debris being sluiced into the streams, rivers and valleys of the Sacramento and San Joaquin, and the possibility of even filling the entrance to San Francisco Bay with the slickens made it imperative that something be done to prevent the wholesale destruction of the rivers and valley lands; and at a State election held in California a vote was taken for or against the stoppage of hydraulic mining, resulting in this great industry and source of wealth being practically abolished with the exception of such localities where the debris or slickens could be impounded by dams or otherwise.

As a result, these great canal systems were now without a purpose, and as the gold quartz mines of the mother lode which were contiguous to the placers, were operated by steam power at a great expense, it was evident with this now available and cheap water power that the operating expenses could be greatly reduced and the problem of a water wheel to be effective under great pressures was next in order.

The question of pipes for heavy water pressures and large capacities had already been solved by the Hydraulic Engineers in the rivetted iron pipe lines throughout the mining districts; as, for example, the Virginia City water works' siphon with a static pressure of 800 pounds per square inch, the pipe being 12 inches in diameter. Rivetted pipe lines as large as 40 inches in diameter were in use in the hydraulic mines of California prior to 1860 and static heads up to 900 feet were common ten years later.

WATER WHEELS.

The Pelton and Knight type of wheels, commonly called the Hurdy Gurdy wheels, were quite extensively used for small power purposes at this time; principally in connection with the hydraulic mines for operating cranes in the removal of boulders, etc., etc. These wheels were rapidly developed to suit the new condition of affairs and with the now available water supply was soon an important factor in hydraulic engineering in company with its mate, the rivetted pipe line. This brings us to the subject of this paper, "Pipe Lines for Water Powers."

The required power having been decided, the next question is the proper size of the pipe line so that the friction loss will not be too great; and secondly, that the pipe is not unnecessarily large in diameter, which, of course, will add greatly to the cost of material and construction, both as regards the transportation and laying, etc.; the pipe being wholly of steel or iron, any excess in diameter means heavier material and expensive work in laying the line. It is usual with engineers, who make a specialty of hydraulic engineering for power purposes, to refer to pipe lines as carrying a stated horse power, and it may be of interest to those who have never given this matter much thought to know that any pipe line of whatever length or diameter has a certain maximum horse power capacity, as is shown in the following table which gives the maximum power of a 30-inch pipe line, 7900 feet long with 420 feet of surveyed head:

Velocity per second.	Friction loss.	Horse Power of pipe.
3 feet	11 feet	684
6 "	38 "	1275
9 "	85 "	1680
11 "	126 "	1800
12 "	153 "	1787

It will be seen from the above that the maximum horse power of this line is 1800 horse power.

In another case of a 20-inch pipe line, 13,200 feet long with 256 feet of surveyed head:

Velocity per second.	Power of line.
3 feet	150
5 "	205
6 "	211
7 "	197

showing the limit of power of this line to be 211 horse power.

Another case, nearer home, for example, The Waianae Plantation power plant, where the pipe line is of 12-inch tubing, the surveyed head being 700 feet, the maximum power of this line is 564 H. P. as in the following table:

Velocity per second.	Power of line.
10 feet	480
12 "	539
14 "	564
16 "	561

CONSTRUCTION OF PIPE LINES.

In the construction of a power plant the main feature to be considered is that the maximum head should be utilized, for the reason that the head is not an item of cost in the operation of the plant, but the water supply for the purpose is a continuous expense, particularly in the Sierras where it approximates 1¢ per 1000 gallons delivered at the Main Ditch or Canal.

PIPE FRICTION.

In regard to the friction in rivetted lines it is usual where the radius for all elbows is not less than 20 times the diameter of the pipe that the line can then be considered as a straight one. Regarding the friction resistance of the rivet heads, edges of the plates, etc., many of our hydraulic engineers assume that the pipe is a smooth one, using the corresponding formulas, and the pipe simply made the height of the rivet heads larger in diameter, which eliminates all questions on that point. However, it has been found in many cases that the friction of rivetted pipe lines is less than some of the formulas allow for smooth cast iron pipes. A formula for the friction head that gives very good results with rivetted pipe lines of large diameter and long radius bends is as follows:

$$\frac{\text{Velocity}^2}{64.4} \times \frac{\text{Cir. of Pipe}}{\text{Area of Pipe}} \times \text{Length} \times \text{Constant.}$$

This constant according to different authorities on rivetted pipes is from .0053, .0054 to .0055. From data taken from the inverted siphons at Makaweli the constant did not exceed .005. In the above formula the velocity is in feet per second and all other dimensions in feet.

MATERIAL OF PIPE LINE.

Regarding the material for pipe lines it has been found that iron is the most durable and less liable to corrosive action; although a steel pipe may have been properly coated in asphaltum, the steel plate is apparently affected by the elements during the course of manufacture and transportation more than is the case with iron; and, as a consequence, on the Pacific Coast where the advantages only of long experience are available, iron plates are used entirely where permanency is a consideration. A great amount of rivetted pipe is used at the present time for gravel mining, and in that case steel suits the purpose, being primarily less expensive, and secondly lighter plate can be used on account of its high tensile strength; and, further, it is only for a temporary requirement.

SAFETY FACTOR.

The factor of safety allowed in the construction of pipe lines is usually 1/4 of the maximum tensile strength of the material, although in lines for hydraulic mining purposes it is not uncommon for the material to be strained to the elastic limit at the rivetted seams approximating 1/2 of the maximum tensile strain.

At the La Grange (California) hydraulic mines an inverted siphon 30 inches in diameter and 1/2 inch in thickness at the lowest point, the pressure is 475 pounds per square inch or approximately 1000 feet of head, the tensile strain on the solid plate being 14,000 pounds per square inch.

Whether the pipe is of steel or iron, it is coated with asphaltum. This is usually the refined article. Prior to the refining of asphaltum on the Pacific Coast, the ordinary rock asphaltum was used, and was equally as satisfactory, but the refined material is less expensive.

COATING THE PIPE.

In regard to the dipping, the main consideration is that the pipe is kept in the bath a sufficient time for it to arrive at the same temperature as the bath; otherwise the asphaltum will peel off.

Another feature as to whether it is soft and sticky, or hard and brittle, is one that is entirely in the hands of the attendant who has the dipping in charge. The condition of the asphaltum is continuously changing, due to the evaporation that takes place while the dipping is in operation.

LAYING THE PIPE.

In laying large or rivetted pipe lines all elbows or changes in the direction of the pipe is preferably made on the ground, for the reason that while a survey may be accurately made and plotted, it is a difficult matter to know where these lines are when the excavation or ditch is made, and any elbows made to drawings always result in disappointment when they are placed in the line, for the reason that it is mpossible to pre-arrange the location of the end of the pipe where it connects with a curved portion, aside from the fact that all survey stakes disappear during the excavation, and the ditch when completed is usually an entirely different grade.

Another feature to be considered is the contraction and expansion of the line and the creeping of same during construction, this being quite a serious matter; for example, a 36-inch pipe line laid some years ago in California, the contraction and expansion amounted to 5 inches in 1000 feet. This pipe was laid on a trestle, encased in wood to protect it from the direct rays of the sun. When the line is in the ground and covered with earth there is no change due to temperature, and, as a consequence, the pipe cannot be covered too soon after it is placed in the ditch.

In all power lines the inlet end should be provided with proper screens to keep out any floating material such as wood or anything likely to block the wheel nozzles, for the reason that a sudden stoppage of the water under a high velocity would be sufficient to wreck the pipe line and perhaps the power station, as was the case in the San Joaquin Electric Company, where the header was provided with safety valves and every possible precaution was taken. Any safety valve arrangement is of little or no practical use to counteract the effect of hundreds or thousands of tons of water in motion and nothing short of the whole end of the pipe line being open at the proper time could be of any possible utility.

WOODEN STAVE PIPE LINES.

Within the past few years wooden pipe lines have been extensively used for irrigation purposes where the head is not excessive, but in any power system the lines take the shortest direction to the power station, and a very short length of wooden pipe will soon get to the point where the iron or hoops are equal in cost to the solid plate. Where long conduits tributary to power systems have been installed, as in the case of the Pioneer Electric Company at Ogden, several miles of six feet in diameter wooden pipe is used, following the contour of the ground, which was extremely rocky and unsuitable for ditching, the wooden stave being preferable to an open flume and less expensive than an iron or steel construction, the pressure in this case being limited to 125 feet of head.

ANNUAL REPORT OF WALTER MAXWELL, DIRECTOR OF THE SUGAR EXPERIMENT STATION OF QUEENSLAND, 1903, 1904.

The experimental work of the station has been continued, and upon the lines established and set forth in preceding reports. This work embraces cultivation, manuring, irrigating experiments, and competitive tests with all varieties of cane that may turn out to have a commercial value for the industry.

Last year the report was largely taken up with the statement of results following "ordinary" and "deep subsoil" cultivation. These experiments were continued with the ratoons of the Rose Bamboo variety, from which variety heavy crops of plant cane were taken last year. As will be shown in the following paragraphs, the cane rot disease has seriously interfered with the results yielded by the ratoon crop.

Ratoons of the Rose Bamboo Variety.—The experiments of last year in cultivation and fertilising were continued with the first ratoon crop of the Rose Bamboo variety. Unfortunately, in December of last year the disease known as cane rot began to appear in this cane, and continued to cause damage right up to the harvesting of the crop. As a consequence, the competitive and experimental value of the different plats was destroyed, and it is now only attempted to give the general results, and not to draw any conclusions from the experiments of a special nature.

The total yield of cane from the 42 plats, covering 3.1 acres, was 59.21 tons, or an average of 19.1 tons per acre. After delivery of the sound cane to the mill, the rotten cane found upon the ground amounted to 28 loads, representing not less than some 35 tons of cane, had it remained sound. The cost of production was £13 17s. an acre, and is stated as a close approximation only, the actual cost, on account of the diseased cane that had to be removed, being very difficult to decide. The value of the Rose Bamboo ratoon cane delivered at Meadowlands Mill amounted to £52 6s., including the federal rebates, being equal to £16 17s. 5d. per acre, thus leaving a balance over cost of production of £3 0s. 5d. per acre.

These figures state the results of the crop consequent upon the disease which attacked it. Had the crop remained sound and healthy it is shown, by the amount of dead cane found, that the yield of cane would not have been less than 32 tons per acre, and the profit would then have been some £10 per acre. The plant crop gave 49 tons per acre.

Owing to the disease which overtook this variety, all the Rose Bamboo ratoons have been ploughed out, and the ground thoroughly exposed to the air, the roots, leaves, &c., being burnt off or totally removed.

It is to be remarked that the Rose Bamboo variety throughout the Experiment Station was subject to the same disease of rottenness already described. Plant cane only ten months old showed the disease in strong force, and a very large proportion of the cane was dead before the time of cutting.

The behavior of the Rose Bamboo raises the question of cane diseases in a most acute form, and especial effort will be made to unfold the nature of these diseases by exhaustive pathological, entomological, and chemical examinations, which it is proposed to have carried out at the Mackay Station.

The Director proposes to reintroduce the Rose Bamboo variety from the Sandwich Islands. At the time that the leading variety of cane of those islands was giving out, the Rose Bamboo was imported from Queensland, when it actually saved the situation for Hawaii upon large areas of land. The reintroduction will show what the effect of the change of climate has been. It it clear that a variety which has rendered such great service to the industry in Queensland should not be given up without every effort being made to enable it to regain its original qualities and productiveness.

In the report of last year it is said:—"Experiments are being conducted to test the cane and sugar-producing powers of different varieties of cane. There are 68 varieties growing at the Mackay Station, and these are now in competition under uniform conditions of treatment. The results, which will indicate the commercial value of each variety as a sugar producer, will come to hand next season." . . . .

"The 68 varieties include standard representative canes from Demarara, Trinidad, South America, Mauritius, Louisiana, New Guinea, and Queensland."

During the month of September the final analyses were made just before the removal of the crop. These final analyses included the determination of the fibre in each variety. In the case of Trinidad Seedling 83 it will be seen that it is an early-maturing cane, and was at its best in the month of June, when the first preliminary analyses were made. It had arrowed completely at that time, and had also commenced to die away at the top. Demerara 74 proved another early-maturing cane, and contained more sugar in July than in September. The following are the analytical data covering all the varieties:

FINAL ANALYSES OF VARIETIES PLANT CROP, 1904.

Serial No.	Country.	No. or Name of Variety.	Date of Analyses.	Age of Cane.	Density of Juice (Brix).	Sucrose in Juice.	Glucrose in Juice.	Purity of Juice.	Fibre in Cane.	Sugar in Cane.	Date of Arrowing.
1	N. Guinea	Mavoe	13-9-04	13 months.	15.4	12.50	1.58	81.2	10.50	11.18	5th June
2	Ditto	Chenoma	13-9-04	ditto	20.1	18.54	.39	92.2	12.37	16.25	
3	Ditto	Oiva	13-9-04	ditto	14.1	11.43	1.71	81.1	9.52	10.34	
4	Ditto	Batoe	13-9-04	ditto	15.1	12.88	1.31	85.3	10.63	11.51	
5	Ditto	Kikarea	13-9-04	ditto	14.1	11.22	1.95	79.9	7.60	10.37	
6	Ditto	Mabuan	13-9-04	ditto	16.8	13.50	2.08	80.4	10.95	12.02	
7	Ditto	Mave	13-9-04	ditto	20.2	18.10	1.06	89.6	8.07	16.64	
8	Ditto	Moo Moo	13-9-04	ditto	14.7	11.66	2.03	79.3	7.80	10.75	16th May
9	Ditto	Oraya	13-9-04	ditto	15.9	13.31	1.86	83.7	11.00	11.84	
10	Queensland	Meerah	13-9-04	ditto	17.3	16.17	0.65	93.5	10.21	14.52	
11	N. Guinea	Iduari	13-9-04	ditto	16.3	13.47	1.74	82.6	10.02	12.12	
12	Ditto	Akewa	14-9-04	ditto	15.4	12.50	2.08	81.2	10.07	11.25	
13	Ditto	Oiboku	14-9-04	ditto	14.0	11.03	2.00	78.8	9.11	10.03	6th June
14	Queensland	White Bamboo	14-9-04	ditto	19.5	17.90	0.66	91.8	12.86	15.60	
15	Ditto	Striped Singapore	14-9-04	ditto	16.5	15.18	0.63	92.0	10.82	13.53	
16	Ditto	Rose Bamboo	14-9-04	ditto	15.8	14.19	0.85	89.8	10.43	12.71	
17	W. Indies	Bourbon	14-9-04	ditto	16.8	15.09	0.66	89.8	10.86	13.45	
18	Louisiana	Louisiana Striped	14-9-04	ditto	18.0	16.56	0.72	92.0	9.80	14.94	14th June
19	Ditto	Louisiana Tiboo Merd.	14-9-04	ditto	16.2	14.83	0.71	91.5	9.41	13.43	16th May
20	Demerara	D 74	14-9-04	ditto	14.7	12.77	0.66	86.9	8.75	11.52	16th May

FINAL ANALYSES OF VARIETIES PLANT CROP, 1904.—(Continued).

Serial No.	Country.	No. or Name of Variety.	Date of Analyses.	Age of Cane.	Density of Juice (Brix).	Sucrose in Juice.	Glucrose in Juice.	Purity of Juice.	Fibre in Cane.	Sugar in Cane.	Date of Arrowing.
21—	Ditto	D 95	14-9-04	ditto	15.2	13.29	1.51	87.4	9.93	11.96	16th May
22—	Trinidad	Trinidad S. 60	14-9-04	ditto	18.3	16.96	0.71	92.7	10.63	15.15	21st Aug.
23—	Ditto	Trinidad S. 83	15-9-04	ditto	11.6	9.50	1.24	81.9	7.44	8.79	16th May
24—	Ditto	Trinidad S. 202	15-9-04	ditto	14.9	13.51	1.13	90.6	9.54	12.22	16th May
25—	Ditto	Trinidad S. 205	19-9-04	ditto	19.9	16.91	2.00	85.0	12.12	14.86	
26—	S. Africa	Yuban	15-9-04	ditto	19.3	15.91	1.55	82.4	12.26	13.96	1st Aug.
27—	N. Guinea	No. 3	15-9-04	ditto	17.3	15.45	0.98	89.3	11.25	13.71	
28—	Ditto	4	15-9-04	ditto	18.8	16.47	1.07	87.5	10.44	14.75	
29—	Ditto	5	16-9-04	ditto	21.1	18.95	0.65	89.8	9.78	17.10	17th May
30—	Ditto	6B	17-9-04	ditto	19.0	16.48	1.45	86.7	10.65	14.72	
31—	N. Guinea	No. 7	15-9-04	13 months.	18.3	16.36	0.71	89.4	11.93	14.41	
32—	Ditto	8A	15-9-04	ditto	19.8	17.74	1.20	89.6	7.29	16.45	
33—	Ditto	11	17-9-04	ditto	18.5	7.75	8.33	41.9	12.08	6.81	16th May (Full)
34—	Ditto	14A	17-9-04	ditto	16.7	14.20	1.64	85.0	7.00	13.20	
35—	Ditto	15	15-9-04	ditto	20.8	19.71	0.55	94.7	8.49	18.03	
36—	Ditto	17	17-9-04	ditto	19.7	18.16	0.63	92.2	11.00	16.16	26th May
37—	Ditto	18	17-9-04	ditto	19.5	17.34	1.36	88.9	8.43	15.88	1st June
38—	Ditto	19	17-9-04	ditto	19.8	17.10	1.62	86.4	9.10	15.54	14th June
39—	Ditto	22	15-9-04	ditto	20.7	19.40	0.68	93.7	8.88	17.68	2nd Aug.
40—	Ditto	24	19-9-04	ditto	20.5	19.60	0.27	95.6	10.72	17.50	

FINAL ANALYSES OF VARIETIES PLANT CROP, 1904.—(Continued).

Serial No.	Country.	No. or Name of Variety.	Date of Analyses.	Age of Cane.	Density of Juice (Brix).	Sucrose in Juice.	Glucrose in Juice.	Purity of Juice.	Fibre in Cane.	Sugar in Cane.	Date of Arrowing.
41—	Ditto	24A	16-9-04	ditto	19.8	17.86	1.43	90.2	8.75	16.30	
42—	Ditto	24B	16-9-04	ditto	18.6	16.29	1.42	87.6	9.49	14.74	
43—	Ditto	26	16-9-04	ditto	16.1	12.92	1.99	80.2	8.07	11.88	
44—	Ditto	32	17-9-04	ditto	21.7	19.70	1.04	90.8	7.82	18.16	26th May
45—	Ditto	35	17-9-04	ditto	20.6	18.51	1.56	89.9	8.60	16.92	
46—	Ditto	37	16-9-04	ditto	18.5	15.16	2.05	81.9	9.40	13.73	25th May
47—	Ditto	38	16-9-04	ditto	19.0	16.94	1.29	89.1	8.30	15.53	16th May
48—	Ditto	39	17-9-04	ditto	20.3	17.56	1.42	86.5	10.04	15.80	
49—	Ditto	40	16-9-04	ditto	18.0	15.52	1.36	86.2	10.32	13.92	14th June
50—	Ditto	41	17-9-04	ditto	18.6	16.16	1.30	86.9	9.62	14.60	
51—	Ditto	47	17-9-04	ditto	20.5	18.00	1.37	87.9	11.25	15.97	18th May
52—	Ditto	48	17-9-04	ditto	20.3	18.35	1.13	90.4	10.70	16.39	18th May
53—	Ditto	49 (green)	17-9-04	ditto	19.6	17.68	1.49	90.2	10.56	15.81	25th May
54—	Ditto	52	19-9-04	ditto	18.6	15.68	1.56	84.3	12.02	13.79	16th May (Fully)
55—	Ditto	54	19-9-04	ditto	19.9	16.85	1.74	84.7	8.71	15.38	18th May
56—	Ditto	55	16-9-04	ditto	17.2	13.81	2.56	80.3	8.77	12.60	5th June
57—	Ditto	56	19-9-04	ditto	19.2	16.82	1.40	87.6	11.88	14.82	
58—	Ditto	60	19-9-04	ditto	17.6	15.21	1.33	86.4	7.11	14.13	
59—	Ditto	64	16-9-04	ditto	19.0	16.95	1.31	89.9	10.10	15.23	
60—	Ditto	65	19-9-04	ditto	21.6	18.73	1.14	86.7	8.95	17.05	25th May
61—	Ditto	66	16-9-04	ditto	20.0	17.20	1.18	86.0	9.19	15.62	16th May (Fully)
62—	Mauritius	Borneo	19-9-04	ditto	15.3	12.37	1.32	80.8	9.64	11.18	19th May
63—	Ditto	Galogo C.	19-9-04	ditto	20.6	17.59	1.04	85.4	9.26	15.96	

FINAL ANALYSES OF VARIETIES PLANT CROP, 1904.—(Continued).

Serial No.	Country.	No. or Name of Variety.	Date of Analyses.	Age of Cane.	Density of Juice (Brix).	Sucrose in Juice.	Glucose in Juice.	Purity of Juice.	Fibre in Cane.	Sugar in Cane.	Date of Arrowing.
64—	Ditto	Bois Rouge	19-9-04	ditto	22.7	20.69	0.31	91.1	10.55	18.51	16th May
65—	Ditto	Bambou Rouge	19-9-04	ditto	16.5	13.45	1.15	81.5	10.47	12.04	
66—	Ditto	Louzier Rouge	19-9-04	ditto	19.2	15.81	1.74	82.3	8.49	14.47	6th June
67—	Ditto	Tamarin	19-9-04	ditto	20.0	17.86	1.39	89.3	10.13	16.05	
68—	Ditto	Settlers	19-9-04	ditto	21.7	20.88	0.34	96.2	9.56	18.88	

The whole of the above analyses were made by Messrs. Anderssen and McCready, Assistant Chemists, who deserve praise for the industry and interest displayed by them in the work. For the analyses 40 running feet, including every stick, big and little, were taken, and formed the samples for the determination of the sucrose, glucose, fibre, &c.

Immediately the analyses were completed the removal of the crop was commenced. The cane from each variety plat was carefully weighed over the station weighbridge, and again at the Meadowlands Mill, to preclude any chance of error. From the mill weights, with the analytical data, including an actual count of the canes, the following table is formed:—

CROP RESULTS OF VARIETIES, 1904.

Serial No. Country.	No. or Name of Variety.	Age of Cane.	No. of Canes per Acre.	Average Weight of One Stick in Pounds.	Weight of Cane per Acre in English Tons.	Yield of Sugar per Acre in Pounds.	Yield of Sugar per Acre in English Tons.
1—New Guinea	Mavoe	13 months	19,603	6.2	54.5	13,671	6.1
2— Ditto	Chenoma	ditto	27,587	1.7	22.7	8,275	3.7
3— Ditto	Oiva	ditto	19,602	3.9	34.8	8,079	3.6
4— Ditto	Batoe	ditto	19,602	6.2	55.0	14,184	6.3
5— Ditto	Kikarea	ditto	16,861	5.5	41.8	9,716	4.3
6— Ditto	Mabuan	ditto	26,136	3.8	44.6	12,026	5.3
7— Ditto	Mave	ditto	26,136	4.7	54.8	20.454	9.1
8— Ditto	Moo Moo	ditto	21,054	5.0	47.3	11,404	5.0
9— Ditto	Oraya	ditto	31,218	3.4	47.9	12,711	5.6
10—Queensland	Meerah	ditto	23,595	3.1	32.8	10,699	4.7
11—New Guinea	Iduari	ditto	25,773	3.4	39.5	10,740	4.7
12— Ditto	Akewa	ditto	35,211	3.2	50.4	12,720	5.6
13— Ditto	Oiboku	ditto	20,331	4.0	36.5	8,201	3.6
14—Queensland	White Bamboo	ditto	17,424	2.9	22.6	7,913	3.5
15— Ditto	Striped Singapore	ditto	10,527	5.2	24.8	7,538	3.3
16— Ditto	Rose Bamboo	ditto	13,068	4.5	26.3	7,497	3.3
17—West Indies	Bourbon	ditto	1,689	3.4	2.6	781	0.3
18—Louisiana	Louisiana Striped	ditto	21,780	2.7	26.2	8,772	3.9
19— Ditto	Louisiana Tiboo Merd	ditto	27,586	3.7	45.8	13,778	6.1
20—Demerara	D 74	ditto	29,040	3.5	45.9	11,855	5.2
21— Ditto	D 95	ditto	19,962	3.3	30.1	8,091	3.6

CROP RESULTS OF VARIETIES, 1904—(Continued).

Serial No.	Country.	No. or Name of Variety.	Age of Cane.	No. of Canes per Acre.	Average Weight of One Stick in Pounds.	Weight of Cane per Acre in English Tons.	Yield of Sugar per Acre in Pounds.	Yield of Sugar per Acre in English Tons.
22—	Trinidad	Trinidad S. 60	ditto	23,182	5.3	55.7	18,911	8.4
23—	Ditto	Trinidad S. 83	ditto	31,944	2.7	39.1	7,717	3.4
24—	Ditto	Trinidad S. 202	ditto	13,794	6.0	37.0	10,130	4.5
25—	Ditto	Trinidad S. 205	ditto	8,780	2.1	8.3	2,784	1.2
26—	South Africa	Yuban	ditto	59,169	2.5	66.9	20,928	9.3
27—	New Guinea	No. 3	13 months	18,150	4.2	34.7	10,668	4.7
28—	Ditto	4	ditto	31,581	3.8	54.1	17,896	8.0
29—	Ditto	5	ditto	30,976	3.1	43.1	16,552	7.3
30—	Ditto	6B	ditto	26,136	2.1	24.6	8,136	3.6
31—	Ditto	7	ditto	22,506	3.5	35.1	11,363	5.0
32—	Ditto	8A	ditto	32,668	4.0	58.9	21,735	9.7
33—	Ditto	11	ditto	42,592	2.6	50.5	7,710	3.4
34—	Ditto	14A	ditto	25,168	2.4	27.0	8,002	3.5
35—	Ditto	15	ditto	27,588	4.8	59.8	24,191	10.8
36—	Ditto	17	ditto	24,180	2.2	24.2	8,788	3.9
37—	Ditto	18	ditto	48,400	2.2	48.3	17,201	7.6
38—	Ditto	19	ditto	28,040	3.1	38.8	13,508	6.0
39—	Ditto	22	ditto	27,225	4.7	58.2	23,080	10.3
40—	Ditto	24	ditto	23,232	6.1	63.5	24,901	11.1
41—	Ditto	24A	ditto	30,606	4.3	58.9	21,537	9.6
42—	Ditto	24B	ditto	26,862	5.0	60.4	19,944	8.9
43—	Ditto	26	ditto	34,122	3.4	52.0	13,848	6.1
44—	Ditto	32	ditto	21,296	3.8	36.4	14,814	6.6
45—	Ditto	35	ditto	34,364	2.5	39.7	15,085	6.7

CROP RESULTS OF VARIETIES, 1904—(Continued).

Serial No.	Country.	No. or Name of Variety.	Age of Cane.	No. of Canes per Acre.	Average Weight of One Stick in Pounds.	Weight of Cane per Acre in English Tons.	Yield of Sugar per Acre in Pounds.	Yield of Sugar per Acre in English Tons.
46—	Ditto	37	ditto	23,595	4.9	52.3	16,092	7.1
47—	Ditto	38	ditto	32,374	3.7	54.1	18,842	8.4
48—	Ditto	39	ditto	33,880	3.2	48.7	17,256	7.7
49—	Ditto	40	ditto	29,040	4.4	57.5	17,950	8.0
50—	Ditto	41	ditto	15,488	4.6	31.8	10,413	4.6
51—	Ditto	47	ditto	22,748	3.7	38.3	13,709	6.1
52—	Ditto	48	ditto	17,908	4.4	35.3	12,963	5.7
53—	Ditto	49 (green)	ditto	19,360	3.5	30.6	10,853	4.8
54—	Ditto	52	ditto	31,460	2.9	41.1	12,724	5.6
55—	Ditto	54	ditto	28,556	3.5	45.7	15,769	7.0
56—	Ditto	55	ditto	32,670	3.7	55.3	15,608	6.9
57—	Ditto	56	ditto	27,588	2.9	36.2	12,023	5.3
58—	Ditto	60	ditto	23,716	3.6	39.0	12,345	5.5
59—	Ditto	64	ditto	21,780	5.8	56.7	19,377	8.6
60—	Ditto	65	ditto	30,492	2.7	37.6	14,364	6.4
61—	Ditto	66	ditto	49,368	2.7	61.8	21,631	9.6
62—	Mauritius	Borneo	ditto	15,972	1.5	10.7	2,682	1.1
63—	Ditto	Galogo C.	ditto	21,780	3.7	36.1	12,938	5.7
64—	Ditto	Bois Rouge	ditto	39,204	2.9	51.3	21,276	9.4
65—	Ditto	Bambou Rouge	ditto	21,780	2.3	22.7	6,142	2.7
66—	Ditto	Louzier Rouge	ditto	33,396	2.9	44.2	14,356	6.4
67—	Ditto	Tamarin	ditto	29,040	3.7	48.4	17,413	7.7
68—	Ditto	Settlers	ditto	31,944	3.6	52.3	22,158	9.8

Upon the foregoing results a further advance in the selection of varieties was made. Previous to the final analyses and the obtaining of the weights, some 16 of the varieties of the highest average promise, as indicated by the factors of value, were selected and planted to furnish seed for a final test and competition between the picked varieties of the several countries. By next March (1905), these plantings will be ready, and 10 of the best varieties, as shown by the highest average of qualities, from all countries, will be selected and brought into competition for final resuls. The following table is a recapitulation of the results given by the 10 varieties that will in all probability enter the final competition:—

ANALYSES AND CROP RESULTS OF THE TEN VARIETIES SELECTED FOR FURTHER EXPERIMENTS IN 1905.

Serial No.	Country.	No. or Name of Variety.	Density of Juice (Brix).	Sucrose in Juice	Glucose in Juice	Purity of Juice	Yield of Cane per Acre in English Tons.	Yield of Sugar per Acre in English Tons. Country.
19	Louisiana	Louisiana Tiboo Merd	16.2	14.83	0.71	91.5	45.8	6.1
22	Trinidad	Trinidad S. 60	18.3	16.96	0.71	92.7	55.7	8.4
32	New Guinea	No. 8A	19.8	17.74	1.20	89.6	58.9	9.7
35	Ditto	15	20.8	19.71	0.55	94.7	59.8	10.8
40	Ditto	24	20.5	19.60	0.27	95.6	63.5	11.1
41	Ditto	24A	19.8	17.86	1.43	90.2	58.9	9.6
42	Ditto	24B	18.6	16.29	1.42	87.6	60.4	8.9
59	Ditto	64	19.0	16.95	1.31	89.9	56.7	8.6
64	Mauritius	Bois Rouge	22.7	20.69	0.31	91.1	51.3	9.4
68	Ditto	Settlers	21.7	20.88	0.34	96.2	52.3	9.8

*Louisiana Tiboo Merd is not at present as high in position as some excluded varieties. There were circumstances during the recent trials which operated against the variety, and this consideration, with the further one that it is the representative of another country, causes it to be included in the "final tests."

This final series of tests will cover three years, and include plant and first and second ratoon crops.

On reviewing the foregoing tables of results, it is noteworthy and of moment to realize how far the newly introduced varieties have exceeded the older Queensland varieties in agricultural and commercial results.

Certain varieties are not yet free from disease. These are being carefully watched, and the utmost care is being taken in order that no cane leaves the station without a clean bill of health.

SUB-STATIONS: EXPERIMENTAL WORK.

It was explained in the report of last year that, in addition to the Central Experiment Station at Mackay, several small sub-stations had been established in the sugar districts that were being conducted in co-operation with the farmers of those districts. The conditions upon which these sub-stations were established, and are being conducted, are set forth in the report of 1902-03, on page 23.

Altogether there were 13 actual sub-experimental stations begun, but several of these failed to furnish results, due to several causes, in two instances the farmers asking to be relieved from continuing the work for domestic reasons, and others for other reasons.

Certain of these sub-stations have furnished results, with full details of cost of production. These will be given first, after which a concise table will follow showing the crop results obtained upon the experimental plats by deep cultivation and manures, as compared with the results obtained by the farmers by ordinary cultivation alongside of the experimental plat.

SUB-STATION, MUNDOO.

This substation consisted of 2½ acres. Two acres, or 4 plats, were ploughed to a depth of 12 inches, and subsoiled to a further depth of 6 to 7 inches, and cross-ploughed three times, The yields of cane were as follows:—

Area.	Cultivation.	Manures.	Tons of Cane.
No. 1—½-Acre	Deep-Subsoiled	Lime and manure	12.58
No. 2—½-Acre	Deep-Subsoiled	Manure	12.39
No. 3—½-Acre	Deep-Subsoiled	Manure	12.49
No. 4—½-Acre	Deep-Subsoiled	Lime and manure	13.38
No. 5—½-Acre	Ordinary		6.08

The manure was composed of lime phosphate, nitrogen (as sulphate of ammonia), and potash (as sulphate of potash), the cost of which is stated in the "cost of production."

In stating the "cost of production," the whole of the deep and subsoil cultivation is charged against the present crop, although the deep ploughing and subsoiling will benefit the succeeding ratoon crops. The whole of the manure is also charged against the present crop, and one-third of the cost of the lime, lime continuing to have effects for several succeeding crops.

COST OF PRODUCTION PER ACRE.

Cultivation.	Nos. 1 and 4. £ s. d.		Nos. 2 and 3. £ s. d.
Ploughing and subsoiling	2 0 0	..	2 0 0
Putting trash in furrows	0 8 0	..	0 8 0
Cost of lime (one-third)	1 0 0	..	..
Applying lime (one-third)	0 4 0	..	..
Cost of manures	3 3 0	..	3 3 0
Applying manures	0 8 0	..	0 8 0
Cost of plants	0 12 0	..	0 12 0
Cost of drilling, cutting, and planting	1 10 0	..	1 10 0
Horse cultivating	0 8 0	..	0 8 0
Hand cultivation	0 7 6	..	0 7 6
Trashing cane	0 16 0	..	0 16 0
Harvesting	3 5 0	..	3 2 0
Total cost per acre	£14 1 6	..	£12 14 6

The "cost of production" by the "ordinary cultivation" is not furnished in detail by Mr. Reid.

The following table sets forth the value and cost of the crop per acre:—

VALUE AND COST OF THE CROP PER ACRE.

Experiments.	Weight of Cane per Acre. Tons.	Value per Acre. £	s.	d.	Cost per Acre. £	s.	d.	Profit per Acre. £	s.	d.
Nos. 1 and 4	26.0	19	10	0	14	1	6	5	8	6
Nos. 2. and 3	24.8	18	18	0	12	14	6	6	3	6
Farmers' Plat	12.1	9	1	6	8	5	0	0	16	6

In continuation of Mr. Reid's report upon the tests, he says: —"I am perfectly satisfied with the results."

(Signed RALPH REID.

The Director has to state that Mr. Reid has not only carried out all instructions faithfully, he has throughout shown an enthusiastic interest in the whole question of experimentation and of the restoration of exhausted soils. The land upon which Mr. Reid has carried out these tests, which land was selected by the farmers' association, is one of the poorest soils of the district, and has been exhausted by previous cropping. If in one year, by the aid of deep and thorough cultivation and selected manures, the crop can be more than doubled upon these washed-out and exhausted lands, then the cane farmer has enough inducement to give attention to the restoration and maintenance of the fertility of his soils.

SUB-STATION, SUNDOWN.

The land selected by the farmers' association, Geraldton, for the experiments at Sundown is alluvial, and although it is not better than an average of the locality, yet it is decidedly better than the Mundoo soil with which Mr. Reid experimented.

The actual yields of the several plats, as stated by Mr. Hart, are as follow:—

Area.	Cultivation.	Manures.	Tons of Cane.
No. 1—½-Acre	Deep-Subsoiled	Manure	12.04
No. 2—½-Acre	Deep-Subsoiled	Lime and manure	12.85
No. 3—½-Acre	Deep-Subsoiled	Lime and manure	14.26
No. 4—½-Acre	Deep-Subsoiled	Manure	11.71
No. 5—½-Acre	Ordinary		10.43

The weights were furnished by courtesy of Mr. Foster, manager of the Colonial Sugar Refinery Company's mill, Goondi.

The cultivation in Mr. Hart's experiments differed from those carried out by Mr. Reid, Mundoo, in so far that the ploughing was only 11 inches and the subsoling 5 inches, thus giving 16 inches of loose soil against 18½ inches in Mr. Reid's case; also, Mr. Hart gave his land one ploughing less than Mr. Reid, the result being that the difference in cultivation between the experimental plats and the check or farmers' plat in Mr. Hart's case is less than in the case of Mr. Reid. The manures and lime applied to Mr. Hart's experiments were exactly the same as in Mr. Reid's tests at Mundoo.

COST OF PRODUCTION PER ACRE.

Cultivation.	Nos. 1 and 4. £ s. d.	Nos. 2 and 3. £ s. d.
Ploughing and subsoiling	2 10 0	2 10 0
Drilling furrows	0 4 6	0 4 6
Plants	0 14 0	0 14 0
Cutting and planting	0 12 0	0 12 0
Hand cultivation	0 11 0	0 11 0

Horse cultivation	0 7 2	..	0 7 2
Lime and application	..	..	1 4 0
Manures	3 3 0	..	3 3 0
Applying manure	0 8 9	..	0 8 9
Trashing	0 12 0	..	0 12 0
Harvesting	2 3 9	..	2 4 4
	£11 6 2	..	£12 10 9

VALUE AND COST OF THE CROP PER ACRE.

Experiments.	Weight of Cane per Acre. Tons.	Value per Acre. £	s.	d.	Cost per Acre. £	s.	d.	Profit per Acre. £	s.	d.
Nos. 1 and 4	23.8	17	17	0	11	6	2	6	10	10
Nos. 2 and 3	27.1	20	7	0	12	10	9	7	16	3
Farmers' Plat	20.8	15	12	0	8	3	8	7	8	4

In a communication accompanying his report, Mr. Hart says: —"The season has not been at all favourable, owing to the drought in the early part and to the extremely wet season in the latter part (the experimental plats were under water to a depth of over a foot for several days), after which heavy windstorms knocked the cane about badly."

(Signed) J. HART.

The chief damage resulting from the season was the leaching out of the manures when the experimental plats were flooded for a considerable length of time. The effects of the deep cultivation were also lost to some extent by the stagnant flood waters lying upon the ground. Nevertheless, the deeper cultivation and the lime and manures gave a notable increase of cane per acre, although the increase was not enough to make the profit larger than was made by ordinary cultivation. In Mr. Reid's case, the result in favour of the better cultivation was specially striking.

SUB-STATION, HALIFAX.

The Halifax Sub-station furnished results last year. The data now given are the result of the first ratoon crop from the experimental plat from which the plant crop was harvested in the season of 1903. The yield of the first ratoon crop was as follows, the weights being furnished by courtesy of Mr. Forest, manager of the Colonial Sugar Refinery Company's mill, Victoria:—

Crops.	Weight per Acre (First Ratoon). Tons.	Total Yield per Acre (Plant and First Ratoon). Tons.
Experimental Plat	25.9	68.4
Farmers' Plat	17.0	42.0

VALUE AND COST OF FIRST RATOON CROP.

Crops.	Weight of Cane per Acre. Tons.	Value per Acre. £ s. d.	Cost per Acre. £ s. d.	Profit per Acre. £ s. d.
Experimental Plat	25.9	25 17 11	15 16 5	10 1 6
Farmers' Plat	17.0	17 0 0	9 9 6	7 10 6

The crop was grown by white labor, and the bonus was 5s. per ton.

(Signed) ANDERSON BROS.

Messrs. Anderson Bros. have carried out the experimental work, covering both the plant and first ratoon crops, exclusively with white labor, as distinguished from Mundoo and Sundown experiments, which were conducted with colored labor. Anderson Bros. have shown a careful interest in the tests, and have carried out all requirements faithfully.

SUB-STATION, WOONGARRA.

The land being used by this sub-station was selected by the "Woongarra Farmers' Association," it being decided that the soil was a fair average of the lands of the district.

This station was delayed in being started by reason of the extreme seasons of drought that had prevailed, the land being in a state of severe dryness and as hard as a road.

In speaking of the ploughing, Mr. Pringle, manager for Mr. Smith, the owner of the land, says:

"The deep plowing and subsoiling were commenced on 15th May, 1903. The land had, for many years, been ploughed only to a depth of 7 inches. At this depth the old roots of previous cane crops were bunched together on the hard bottom of the old furrows, the roots not having been able to penetrate deeper. By the deep ploughing and subsoiling for the present crop a depth was reached of 18 inches, or 2 inches less than the Director of the Sugar Bureau had instructed; but owing to the hardness of the ground this was the greatest depth that could be reached.

"At the time of furrowing the first acre for planting, the ground was too wet from a recent rain. Going on the land while it was wet had a very bad effect, which has stuck to the crop all through. Owing, also, to the instructions of the Director not being fully carried out, the Hawaiian method of irrigation could not be followed, the result being that the water applied to the irrigated plats lost much of its effect.

"The season has been most unfavorable, there being an excess of cold rain in October and a severe drought during the balance of the growing season. During the hot months of January, February and March, when the chief growth of the year is made, only 6.9 inches of rain fell, instead of some 30 inches, which is the normal amount.

"The experimental area comprises 3 acres, all of which was deeply cultivated and subsoiled. One-half of the area was irrigated, the other half being non-irrigated.

YIELD OF CANE PER ACRE.

Irrigated cane	30 tons per acre,
Non-irrigated cane	16 tons per acre

"The cost of production of the irrigated and non-irrigated areas was as follows:

COST OF PRODUCTION OF THE CROP.

Cultivation.	Irrigated (Cost per Acre).			Non-Irrigated (Cost per Acre).		
	£	s.	d.	£	s.	d.
Ploughing and sub-soiling	3	16	8	3	16	8
Harrowing	0	1	0	0	1	0
Rolling	0	2	0	0	2	0
Plants	0	12	0	0	12	0
Cutting and planting	1	12	6	1	12	6
Horse cultivation	0	12	0	0	12	0
Hand cultivation	0	11	0	0	11	0
Manure	2	13	4	2	13	4
Applying manure	0	3	4	0	3	4
Trashing	1	2	6	1	2	6
Irrigating	6	2	8	.	.	.
Harvesting	4	10	0	2	7	6
	£21	19	0	£13	13	10

VALUE AND COST OF THE CROP.

Crops.	Yield per Acre. Tons.	Value per Acre. £ s. d.	Cost per Acre. £ s. d.	Profit per Acre. £ s. d.
Irrigated Area	30	27 8 5	21 19 0	5 9 5
Non-Irrigated Area	16	14 13 4	13 13 10	0 19 6

(Signed) GEORGE PRINGLE,
Manager for A. H. Smith.

As Mr. Pringle has fully explained, the season was extremely unfavorable. The drought was very severe, and from December to April the crop was almost at a standstill when it should have been making its chief growth. Nevertheless, after all the heavy costs of deep ploughing and subsoiling and manures are charged against the crop, a small profit is made even upon the non-irrigated areas. The value of the deep cultivation, as well as that of the manures, still remains in the land. The crop was thirteen months on the ground, and while it amounted to 16 tons per acre other plant crops of the same age, grown on better land in the locality, were averaging 8 to 9 tons per acre, according to the statements of Mr. Pringle.

ECONOMIC.

The sugar crop of 1903 was greater than the crop of 1902 by 15,202 tons.

The area of cane cultivated in 1903 was 111,516 acres, the second largest area on record.

The area of cane crushed and manufactured in 1903 was 60,375 acres, giving a yield of 823,875 tons of cane and 91,828 tons of sugar.

The yield per acre in 1903 was 13.65 tons of cane and 1.52 tons of sugar.

PRODUCTION IN THE THREE DISTRICTS.

Districts.	Cane Produced (English Tons).	Sugar Produced (English Tons).
(1) Southern (Bundaberg)....	196,007	19,062
(2) Central (Mackay)........	258,496	28,433
(3) Northern (Cairns)........	369,372	44,333
Totals	823,875	91,828

It is thus seen that over 79 per cent. of the total sugar grown by the State was produced in the Mackay and Northern districts, the Northern district producing 48.2 per cent. of the output of the State.

It has been stated that the area of cane crushed in 1903 was 60,375 acres out of a cultivated area of 111,516 acres, leaving 51,141 acres of uncrushed cane, which residue would provide a large proportion of standover cane with which to begin the crushing of the current year, 1904. That residue is already entering manufacture, and the tonnage to be crushed in 1904 will be the second largest on record.

These data are furnished by the State statistician, and they show that, in 1903, 25.7 per cent. of the total cane crushed was harvested by white labor, as compared with 16.5 per cent. in the year 1902.

THE RELATION OF THE SUGAR INDUSTRY TO THE STATE.

In preceding reports data have been published showing the value and importance of the sugar industry to the State, and to determine its place as an article of export, compared with the exports of other agricultural crops, and with the net exports of all articles of consumption.

ESTIMATED VALUE OF THE SUGAR CROP OF 1903.

Volume of Crop, 91,828 *tons.*

Value of exported sugar and molasses	£ 647,558
Value of sugar reserved for home consumption	451,199
Value of uncrushed cane	409,000
Value of cane feed, molasses, etc	120,000
	£1,627,757

These figures deal only with the total production of the crop of 1903, and do not include reserve stocks from the crop of 1902.